The FOUNDRY

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Castings Aid in Production of Electrical Wire

PRACTICALLY every home in America is equipped with electrical conveniences such as electric lights, washing machines, toasters, stoves and many other appliances. These would not be possible were it not for the copper wire that is incorporated in them and that is used to transmit the power upon which those pieces of apparatus depend. Indeed, the power itself

Wire Drawing Machines Make Possible Many of the Conveniences Enjoyed in the Modern Home

could not be generated, for modern electric power producing equipment contains much copper wire. In 1925, according to the biennial census of manufacturers, issued by the department of commerce, over 250,000 tons of copper wire were made. The process of manufacture is complicated. First the copper must be reclaimed from the ore and cast into ingots. It then is rolled and drawn to the size specified by the consumer. He often requires finer wire and again draws it to a smaller size in machines, one type of which is shown in the accompanying illustration. These machines contain a series of dies that reduce the size of the wire by steps to the required diameter which often is extremely fine. Some wire is made so fine that it is difficult to see. Such operations require extremely accurate and rugged apparatus. Castings are used as the base and the case enclosing the machine. Many parts of the machine itself are products of the foundry.

Find Where Castings May Be Sold

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Ford Introduces
New Coremaking Methods

By Pat Dwyer

OWING to the many remarkable features incorporated in the methods and equipment of the Ford Motor Co. foundry at the River Rouge plant, Dearborn, Mich., with a potential daily pouring capacity of 2500 tons of gray iron, reference and description have appeared on many occasions in newspapers, business and technical publications. Original description of the building, the equipment and methods for making the molds, for melting and pouring the iron and for cleaning the castings was presented in THE FOUNDRY Oct. 1, 1921. Radical changes in the method of preparing the metal, combining blast furnace and cupola iron and then superheating the mixture in an electric furnace, formed the basis for an extended article

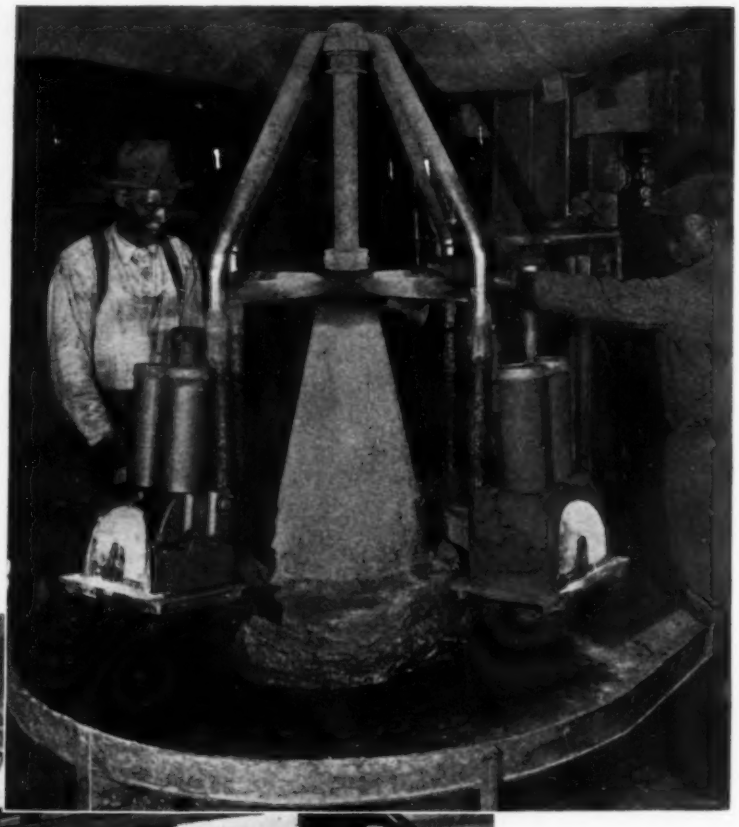

Fig. 1 (Left)—Ingot Mold Molds Are Assembled Horizontally and Then Placed Vertically in the Pit Shown to the Right, Where They Are Filled With Iron. Fig. 2 (Above)—A Light Coating of Talc on the Cope Side of the Core Prevents the Blacking From Adhering to the Surface

Fig. 3—Hinged Flasks, Iron Patterns, Iron Plates and Cotter Pins Instead of Bolts Constitute Some of the Interesting Features on the Ingot Mold Floor

published in THE FOUNDRY on Sept. 15, 1927.

Comparatively few people outside those directly interested know that the company operates a second foundry at the River Rouge plant, separated by a few hundred yards from the immense production foundry that has figured in the news of the day on innumerable occasions. In comparison with the production of the first foundry, this second foundry rates from 5 to 8 per cent with a daily output of between 150 and 200 tons. In variety of castings, it is doubtful if any other general jobbing foundry in the country equals the wide range covered. Ramifications of the Ford industries extend into practically every line of manufacture and most of the castings required for repair and maintenance are made in this foundry.

The foundry is equipped to handle castings of any weight that are needed, or likely to be needed. THE FOUNDRY, Aug. 1, 1925, contained an interesting description of the methods employed in producing eight sets of castings for specially designed, steam, turbo-generators for the main power house. Each unit was designed to deliver 62,500 horsepower or a total of half a million horsepower for the entire installation. The generator was one third smaller than any other with a similar capacity. The ventilating system was designed on an original principle. The generator furnished current at 13,200 volts. Some of the castings were the largest and heaviest ever made for a like purpose.

For example, the turbine housing complete weighed 78 tons. The exhaust housing weighed 63 tons. One part of the condenser shell weighed 71 tons and the entire condenser weighed 165 tons. The stator frame weighed 50 tons. A series of dry sand cores were assembled in a pit to form the molds for these castings.

In common with all the buildings in this immense plant—a feature which obtains in all Ford properties—the foundry 200 x 500 feet, is mostly steel and glass in the side and end walls and the roof. This style of architecture insures a maximum amount of daylight, while ample ventilation is secured by manipulating movable sections in the window sash in the walls and in the roof. The shop is lighted electrically for night work and in winter is heated by radiators extending along the side walls from the lower side of the windows to the floor line.

The foundry building follows the usual three-

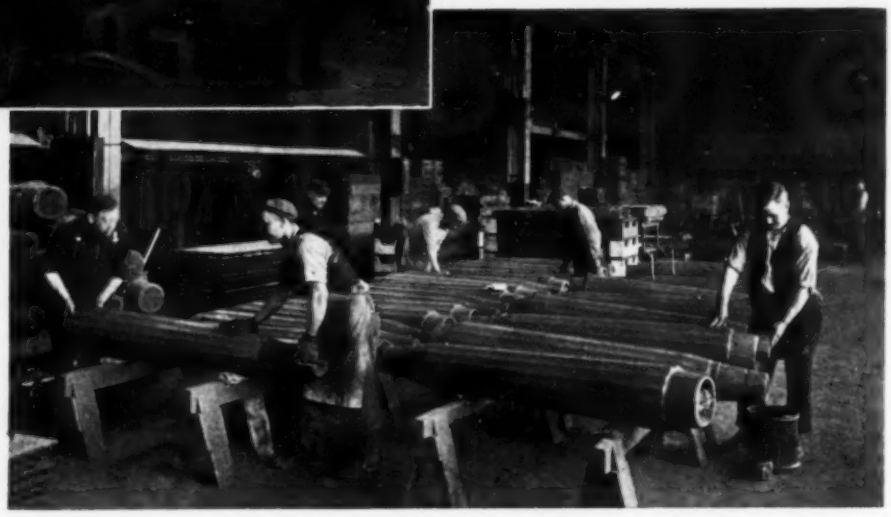

Fig. 4 (Left)—Ingot Mold Cores Are Made in Halves on a Rollover Machine. Fig. 5 (Below)—After the Ingot Mold Cores Are Dried in Halves They Are Assembled in Pairs and Made Ready to Place in the Molds

bay style found in practicaly all shops where cranes are employed extensively. The first bay, shown almost in full in Fig. 3 and partly in Fig. 1, is devoted to the production of ingot molds for the open hearth department; also a wide range of medium weight and heavy castings.

Small and medium weight castings, both iron and steel, are made in the center bay. Approximately one quarter of the floor space in this bay commencing at one end is devoted to the production of steel castings. The steel is melted in a 3-ton electric furnace made by the Pittsburgh Electric Furnace Corp., Pittsburgh. Castings are cleaned in a space set aside for the purpose and equipped with the necessary facilities at the opposite end of the same bay. This bay is traversed by a wide central gangway for the transportation of the many materials and pieces of equipment required in daily routine production.

System, order and cleanliness are cardinal principles with Henry Ford and perhaps the greatest tribute to his genius, an active acknowledgment that he is the center, the exceedingly active center of his organization, is found in the fact that these principles are exemplified in the extensive grounds, the buildings and in the equipment connected with his various manufacturing enterprises. A general jobbing foundry admittedly presents a difficult proposition in this respect, but solving difficult problems seems to be part of the daily routine in this institution. Several men devote their entire time daily to keeping everything spic and span in the foundry.

With the exception of a space in the center occupied by the core ovens and cupolas, the entire third bay is given

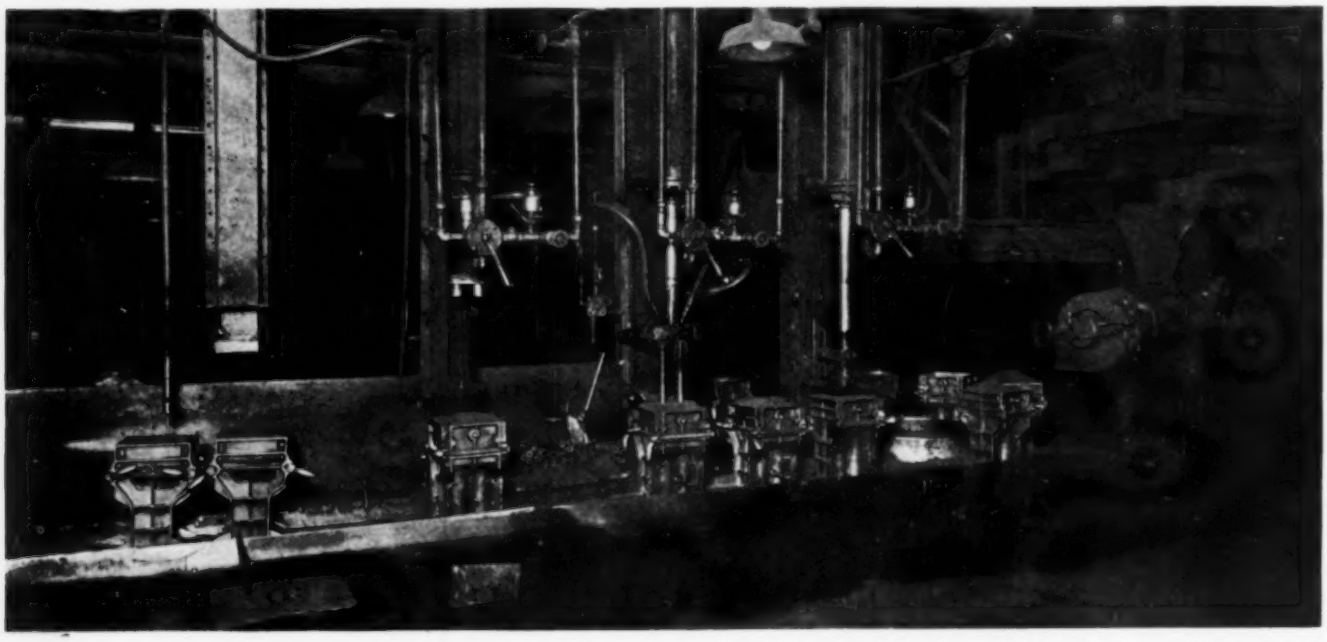

Fig. 6—One of the Body Coremaking Units With the First Plunger in the DOWN Position, the Center Plunger At the Beginning of the Stroke, and the Third Plunger in Position to Leave Clearance for the Two Arbors

Fig. 7—In This Illustration the Position of the Various Plungers Has Been Reversed. The First Plunger Is Up, the Second Is Part Way Down, and the Third Has Forced the Arbors Into the Core

over to the activities of the core making department. Views in the section where the ingot mold cores are made and assembled are shown in Figs. 4 and 5.

Cost figures are not available, therefore no comparison may be drawn in that respect between ingot mold and core making methods in the Ford foundry and those pursued elsewhere. For many years the universal practice in ingot mold foundries has been to form the mold and core in an upright position. Usually they are formed and dried independently of each other and afterward assembled for pouring. In some instances the pattern forms both mold and core, but this method prolongs the drying period.

With characteristic defiance of convention, Ford through his foundry department developed an original method for making these castings. They are molded horizontally and cast vertically. The ingot is circular in cross section and is fluted longitudinally. The flutes are comparatively wide and shallow, therefore the core drops readily from a metal corebox split longitudinally on a center line.

The metal corebox designed to form two half cores and shown to the left in Fig. 4 is mounted on jolt, ram, roll-over machine. A cast iron skeleton arbor is employed to reinforce each half core and the sand is shoveled into the box from a pile at the rear. After the sand is rammed, a considerable amount is scooped from the center to shorten the drying period and incidentally produce a core that will crush more readily during the contracting period of the casting. Also an appreciable amount of sand and

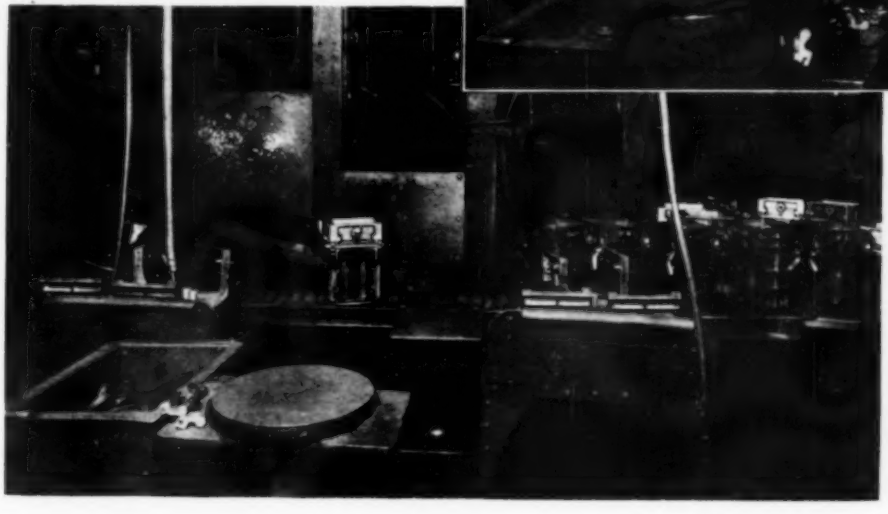

Fig. 8 (Left)—The Finished Core Is Removed From the Conveyor at This Point and Capped to Prevent Distortion. Fig. 9 (Above)—Close Team Work Is Necessary in Making Cylinder Body Cores

binder is saved in this manner.

Perforated aluminum plates, strongly ribbed on the back and planed to a flat surface on the face, receive the cores from the corebox and support them during the green and drying periods. They are loaded in tiers on the core oven cars as shown at the back of the illustration Fig. 5 and dried in a battery of ovens supplied by Young Bros., Detroit.

Dried half cores are assembled in pairs on horses as shown in Fig. 5. The two arbors are clamped together at the large end and a strand of wire is wound in a groove at the upper end. The dried cores are loaded several tiers deep on trucks and taken to the molding and pouring department shown in Fig. 1. Here each core

Fig. 10—Green Cores Are Lifted From the Blacking Bath to the Oven Rack

in turn is lifted by a wide leather strap attached to the crane chains and placed in a waiting drag mold. The core prints at each end fit snugly in corresponding prints in the mold and support the core in a truly central position, first in a horizontal and later in a vertical position.

Metal half patterns, one of which is shown in the foreground Fig. 3, are mounted on accurately machined cast iron plates supported about 8 inches above the floor. Each plate is equipped with a pair of rollup concave hinges at one edge and each half flask is equipped with a corresponding pair of convex hinges. Pattern for a long down gate and inlet are attached to the drag pattern and plate.

Each flask contains only four bars thus greatly facilitating the work of the rammers, but the sides of the flasks are corrugated instead of flat and thus prevent the sand from sliding during the rollover operation. The pattern plate remains stationary. A pair of crane chains is attached to two handles and by moving the bridge the flask is swung up on edge on the hinges. It is then lifted clear and lowered on its back in a clear space between the ramming station and the drying ovens. Here any necessary minor repairs are effected before the face of the mold is blackwashed and before the mold is loaded on one of the oven cars. Two large ovens made by the Ford Motor Co., are in constant use.

In addition to the hinges, several other ingenious devices have been adopted to simplify and hasten the operation of handling the molds. Cotter pins and key wedges are employed instead of the usual bolts or clamps for attaching the bottom plates to the flasks and later for joining the copes and drags. These are applied more rapidly than bolts, besides doing away with a form of aggravation, more common in the foundry than elsewhere, bolts with stripped threads. They are more positive in action than clamps and wedges which slip occasionally, especially where a flask has to be shifted from a horizontal to a vertical position and then transported for any distance.

The dried molds are assembled on an open floor space as shown in Fig. 1. Then they are upended and placed in a shallow pit 75 feet in length enclosed in a concrete wall 3 x 3 feet which also serves as a platform for the men making up the runners and for the men who pour the iron. Each mold is provided with a single high riser on the opposite side from the runner. All these features are shown clearly in the accompanying illustrations. Metal for pouring the castings is brought from the cupolas in the center bay in the type of buggy and ladle shown in the foreground Fig. 1. It will be noted that the wheels of the truck are guarded to prevent accident.

The castings are shaken out at night and removed to the cleaning room. Flasks and plates are stacked at a convenient point for the following day's molding operations. The sand is cut over and riddled and then transported by grab bucket suspended from the crane to a point near the ramming station.

One of the advantages of the present method is its flexibility in meeting open hearth requirements and in adjusting itself to general conditions in the foundry. In lean periods a few men can operate the equipment. In periods of stress the number can be increased to secure a maximum output of 56 molds per day. The management now contemplates the installation of a jolt-ram-rollover machine for molding these castings in flasks that will not require any bars.

More Changes Made

Many changes in methods and equipment have taken place in the production foundry of the Ford Motor Co., since a previous description appeared in THE FOUNDRY, a few years ago. One of the most interesting from an operating viewpoint is shown in the accompanying illustrations. The process furnishes another illustration of the well known fact that seeming impossibilities frequently are solved in the simplest and most obvious manner. After the discovery, one is moved to wonder why the solution to the puzzle did not arrive more readily.

The body core, that is the core which forms the inside of the crankcase and barrels, is made in two equal parts, with half the crankcase section and two barrel cores integral in each part. Thus for the present approximate output of 8000 engines per day, 16,000 core blocks are required. The core is made, blacked, dried and transported in a vertical position and does not assume the horizontal position until it is placed in the mold.

Metal coreboxes accurately machined and fitted in several sections are employed to form these cores. A length of perforated steel pipe 1¾ inches diameter at one end and tapering down to 1¼-inch, extends through each barrel core and through the body of sand forming the crankcase and core print.

In the original method each of these

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Paper Mills Absorb *Many Castings*

By P. D. Forbes

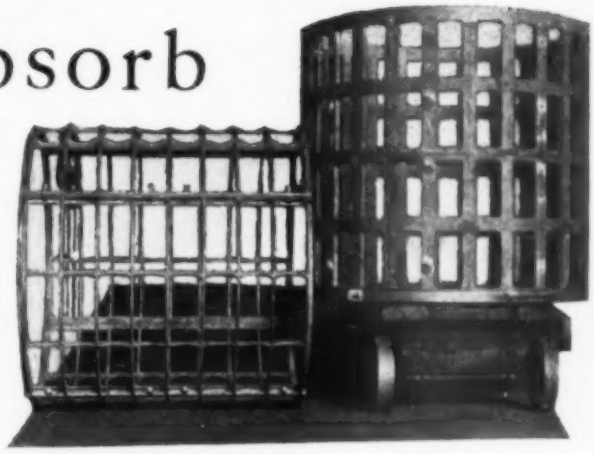

Fig. 1—Bronze Screens for Paper Mill

ACCORDING to the best authenticated records the month of May this year marked the centennial of the first successful operation of a locally built paper mill in the United States. The machine was built in 1828 at the original plant of the present Smith & Winchester Manufacturing Co., South Windham, Conn., a company that still is engaged extensively in the same line of business. An interesting description of the foundry methods pursued at this plant was presented by H. R. Simonds in the Aug. 1, 1926 issue of THE FOUNDRY.

Drawings for the patterns of the first machine were made on smooth pine boards and then planed away to make room for succeeding drawings. The patterns were taken to the nearest foundry at Stafford 20 miles away and the castings were hauled back to Windham by oxen. The machine was erected in an old school house which had been moved to South Windham to take advantage of power derived from a small stream dammed for the purpose. The only power driven tool in the shop was a crude lathe. Most of the finishing and erection was performed by hand.

Compared with the highly finished and highly efficient modern paper making machine, this first example was an exceedingly crude device; but when one considers the conditions under which these pioneer machine builders had to operate, one is forced to admit that they made a creditable showing, working as they did for a considerable period each day and night under the flickering glimmer of whale oil lamps.

Probably more actual skill and experience were needed by these men than are needed today in the modern paper machinery plant staffed with specially trained, mechanical engineers, draftsmen, patternmakers, molders, machinists, erectors, electricians, etc.

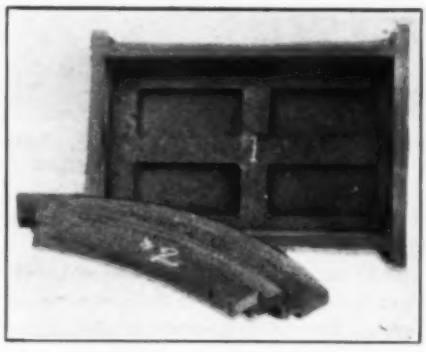

FIG. 2—COREBOX FOR BRONZE SCREEN

The first American paper making machine went into successfull operation in May 1828 at a paper mill located at Norwich Falls, Conn. Including a number of extra parts the total cost was approximately $3000. The total weight of the machine was 10 tons and its capacity was about 1½ tons of finished paper per day.

Contrast this with a machine recently completed by Bagley & Sewall Co., Watertown, N. Y., 304 inches wide, 300 feet in length, weight over 2000 tons made up of over 2300 castings ranging in weight from a few pounds up to 30 tons. A machine of this type has a capacity of 150 tons of paper a day and costs about $500,000. With a large amount of auxilliary machinery and a fireproof building, the cost of one of these machines installed will exceed $1,000,000.

Paper making involves three distinct operations: Grinding the wood pulp, making sulphite pulp and actually creating the roll of paper. Each department calls for castings of a distinctive character. Transmission of approximately 25,000 horsepower, derived from water or electric current, involves the use of many large, strong castings, couplings standards, frames, cylinders, rolls, etc.

In addition to over 2000 iron, steel and brass castings, the modern paper making machine contains a large number of auxiliary devices containing

FIG. 3—LARGE CORED CASTINGS FOR GRINDER. FIG. 4—THESE Y-VALVE BODIES ARE USED EXTENSIVELY. FIG. 5—PATTERN FOR A FRAME THAT WEIGHS APPROXIMATELY 2000 POUNDS

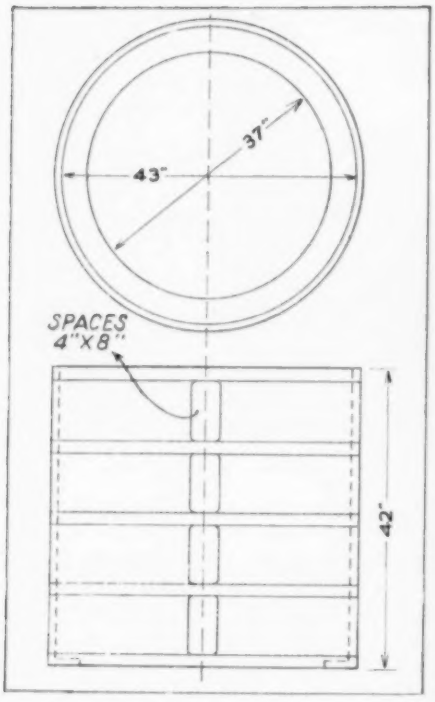

FIG. 6—THE VERTICAL LINE OF OPENINGS IN THE CENTER SHOWS HOW THE CORES WERE APPLIED

an extensive quantity of castings, some of them highly intricate. The pattern for a heavy frame 18 x 76 inches and weighing about 2000 pounds is shown in Fig. 5. A side frame for a grinder, extensively cored and weighing 750 pounds is shown in Fig. 3.

Majority of the castings in the sulphite department are made from an acid resisting bronze to withstand sulphuric and sulphurous acids (H_2SO_4 and H_2SO_3). Fig. 4 shows a 6-inch *Y*-valve in common use, weight 225 pounds.

After the paper passes over the dryers it receives a final finish in a stack of calander rolls, a series of

FIG. 8—THE BOSSES ARE ATTACHED LOOSELY TO THE MAIN PATTERN

chilled iron rolls mounted in strong, upright cast iron frames. In a typical stack recently completed by the Farrell-Birmingham Co., Ansonia, Conn., the bottom roll is 36 inches diameter, 298-inch face and weighs over 50 tons. The second roll from the bottom is 24 inches diameter and

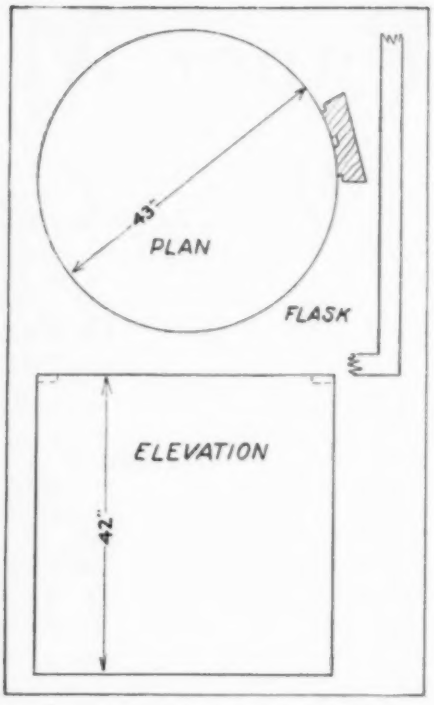

FIG. 9—THE ENTIRE MOLD WAS ENCLOSED IN A FLASK AS SHOWN AT THE UPPER RIGHT

six succeeding rolls are each 20 inches diameter.

The dryer shells are next in weight to the calender rolls. A dryer shell is a plain cast iron cylinder in varying diameters up to 5 feet and up to 310 inches in length. It is machined inside and outside to insure a uniform thickness and balance is provided with internal flanges at the ends to which the heads are attached.

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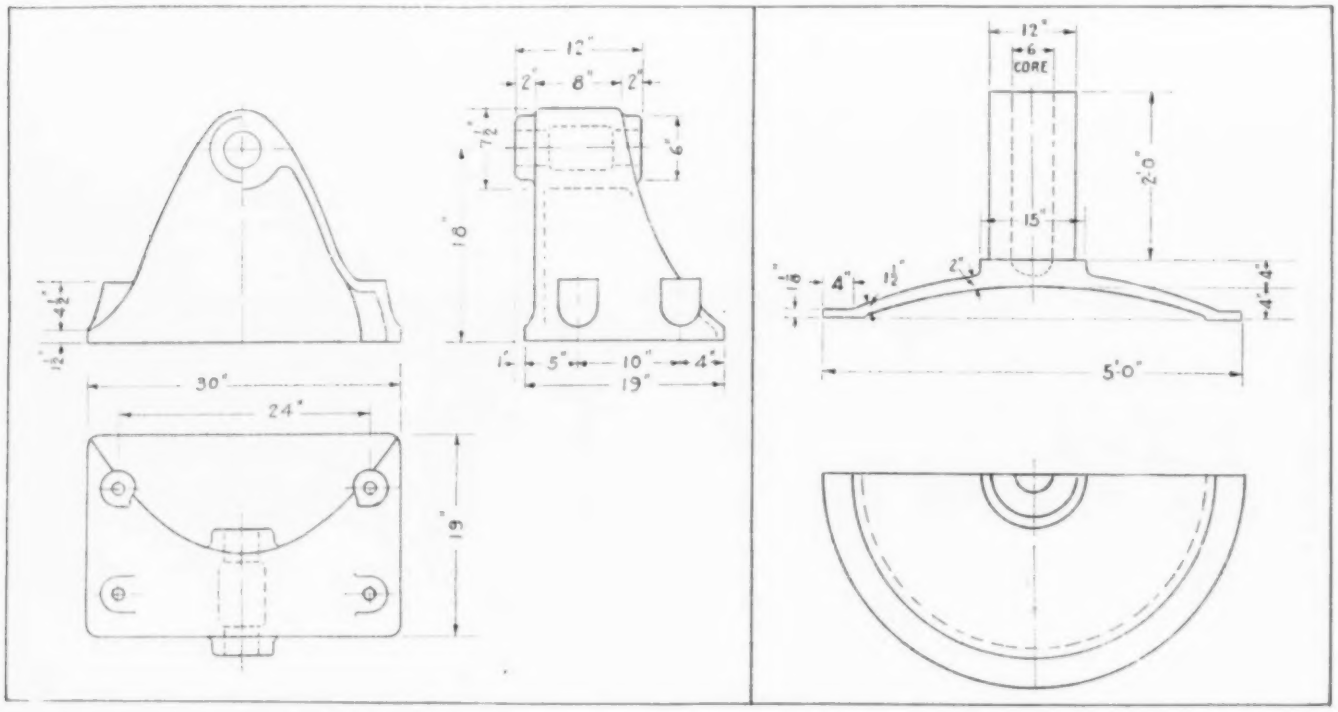


FIG. 7—WORKING DRAWINGS OF THE PATTERN SHOWN IN FIG. 8. FIG. 10—DRYER HEAD CASTINGS USUALLY ARE POURED WITH THE BEARING IN THE COPE

Results Show Shear Test *IS UNSATISFACTORY* for Testing Cast Iron

By W. Jolley

SINCE the formation of the standard specification for general gray iron castings, grades *A* and *C* arranged by the British Engineering Standards association, the author, who was a member of the standards committee represented by the Institute of British Foundrymen and British Cast Iron Research association, has carried out a series of tests to see if the specified tests are the best methods to represent the differences met with in cast iron. In looking through recent literature on the methods of testing cast iron, the predominant feature appears to be the suggestion for the substitution of a shear for the tensile test.

In practically every case, the writers who suggest these changes state that the tensile test on cast iron is unreliable as any deviation from a straight pull gives erroneously low tensile results and should be abandoned as the metal cannot be classified suitably by means of it. The results of these low tensile tests are therefore against the metal and not in its favor. Does this not then point to the fact that it is for the foundryman to adopt loading methods for his tensile tests from which he can obtain reliable results?

In carrying out a series of tests with duplicate and triplicate tensile test bars the author never has found any wide discrepancy in the results between bars (1) truly axially loaded, (2) ordinary ball tackle, (3) slight setting from a straight pull. The point of fracture on the tensile test piece does not appear to make any material difference. J. W. Bolton, *Transactions*, A. F. A., 1928, appears to have had similar results, and he states that carefully conducted tensile tests made on reasonably aligned equipment will give useful results, and the wider use of tensile tests by foundries deserves encouragement. Also the results of tensile tests using Robertson shackles and regular ball joint equipment did not show any wide variation.

From this data and other investigators' work on this subject, it appears that the tensile test, if correctly carried out, can be made a satisfactory test, also it is a test in conjunction

Finds Drawbacks

FROM time to time it is suggested that the shear test be substituted for the present tensile and transverse tests as a method for determining the physical properties of cast iron. However, a decided lack of agreement is apparent on the relation between tensile strength and shear strength. In this article the author, who is superintendent of foundries and pattern shop of Metropolitan-Vickers Electrical Co. Ltd., Manchester, England, presents the results of an investigation on the shear test. He finds that shear test is not satisfactory for testing cast iron, and that tensile and transverse tests yield concordant results.

FIG. 1—TWO VIEWS OF THE ASSEMBLING FLOOR SHOWING THE WIDE VARIETY AND DIFFERENT SIZES OF CASTINGS MADE IN THE FOUNDRY

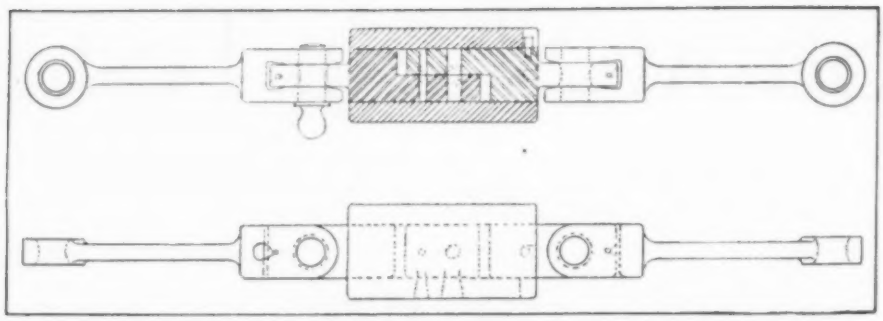


FIG. 2—SHEAR TESTING DEVICE FOR 0.22-INCH AND 0.500-INCH DIAMETER CAST IRON TEST PIECES

with the transverse test that is specified by a large number of engineers who derive a large and comparative amount of information from it. It is, therefore, necessary for the foundryman to meet this test and not to offer the engineer a substitue, because the test he specifies cannot be obtained regularly unless carefully controlled methods are adopted. Engineers desire carefully controlled methods in the production of the work they design.

In considering the shear test methods, the first consideration is the method for obtaining the test specimen. This is obtained by trepanning a 0.22-inch diameter piece from any regular part of the casting. The writer has tried various tools to obtain both 0.22-inch diameter and 0.5-inch diameter test pieces, but has not been successful in obtaining a perfectly round bar. Variations between 0.002 to 0.007-inch have been found to exist in one bar, also the surface is irregular and does not have a smooth finish like the machined test piece. Elliott, *Transactions*, A. F. A., 1926, and others found similar difficulty when investigating this method of testing, and it is the author's opinion that to obtain a satisfactory accurate test piece, so as to avoid bending strain, the sample either will have to be ground or turned to exact size that has been specified.

Lack of uniformity in shear test results makes one consider what results other workers have obtained, and in the relation of tensile to shear we find figures that are not in agreement, as the following will show:

Fremont, *Transactions*, A. F. A., 1912, states shear test results equal tensile test results.

Ronceray, *Proceedings*, I. B. F., 1921-22, states shear equals tensile.

Siegle, *Foundry Trade Journal*, Nov. 23, 1922, found that the shear/tensile ratio was 1.2 to 1.4 on gray irons. No relation with mottled or white irons as shear strength was high and tensile tests on such material gives lower results.

Elliott, *Transactions*, A. F. A., 1926, found that the shear/tensile ratio ranged from 1.14 to 1.31.

Rother, *Transactions*, A. F. A., 1926, found that the shear/tensile ratio was 0.75.

Audo, *Proceedings*, I. B. F., 1926-27, found the shear/tensile ratio to be from 0.916 to 1.2.

Thomas, *Transactions*, A. F. A., 1926, stated that the shear/tensile ratio ranged from 0.9 to 1.00.

Rudeloff, *Die Giesserei*, Aug. 14 and 21, 1926, found the relation of shear to tensile, with a 0.79-inch diameter test piece from 1.2-inch diameter bar, 0.67 ratio; with a 0.59-inch diameter test piece from 1.2-inch diameter bar, 0.64 ratio. Methods of obtaining test pieces were different from other investigators.

English Workers (private communications) found that on a number of tests carried out that the shear/tensile ratio varied from 1.00 to 1.8.

Table I

Tensile Tests Taken from Block

DIMENSIONS AND POSITIONS GIVEN IN FIG. 6

Position	Ultimate tensile strength per sq. in. Tons
Between 1 and 2	10.6
Between 3 and 4	11.2
Between 5 and 6	9.1
Between 7 and 8	9

Tensile specimens were cut from casting at right angles to direction in which shear tests were taken.

In comparing these results with such wide differences, and also widely different methods of obtaining test pieces and correlative test results, the author carried out a series of tests to obtain further information on the subject. At the foundries the author controls, it is the practice to take daily tests on all large castings made for the electrical plant, some of which are shown in Fig. 1. The majority of these are made to specification and under the supervision of inspectors of the leading consulting engineers of England (including British admiralty), Australia, New Zealand, Japan, Russia, India, Holland, Spain, etc.

Tests taken are from test bars cast on the castings and broken off by

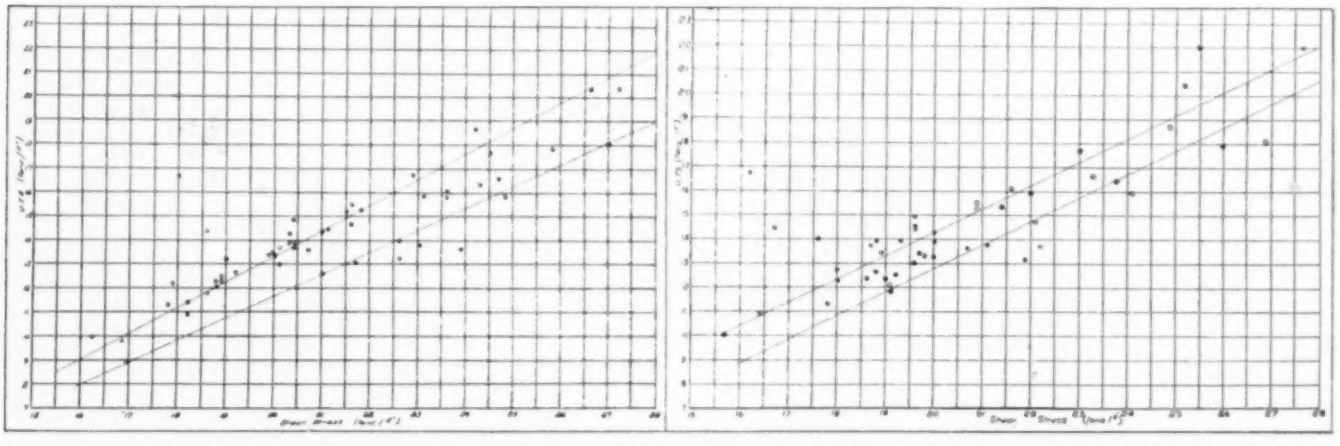


FIG. 3—SHEAR TESTS ON 0.5-INCH DIAMETER SPECIMENS OF CAST IRON AND SEMISTEEL. BAR CAST 1-INCH SQUARE, MACHINED TO 0.5-INCH FOR TENSILE TEST. TENSILE BAR USED LATER FOR SHEAR TEST. FIG. 4—SHEAR TEST ON 0.22-INCH DIAMETER SPECIMENS OF CAST IRON AND SEMISTEEL. BARS CAST 1-INCH SQUARE. MACHINED TO 0.5-INCH FOR TENSILE TEST. TENSILE BAR USED LATER FOR SHEAR TEST AFTER MACHINING TO 0.22-INCH

the customer's inspectors who mark the test bars. These bars are 1¼ x 14 inches and are machined to 1 inch square for the transverse test. After being tested on 12-inch centers (the deflection is taken during this test) the broken half is machined to 0.564-inch diameter 2-inch gage length for a tensile test. The other half is used for brinell hardness, chemical analysis and microscopic tests. The other bar is held for any duplicate tests which may be required.

For the daily routine test, over a period of six months, the tensile test bars were machined to 0.5-inch diameter and the broken piece was used for the shear test, as only a piece 1 inch long was required. By this method the author considered that variables are eliminated due to varying sections from which the tensile and shear test specimens were taken.

Variations in the relation between shear, tensile and transverse occur with different compositions and structures, and no formula apparently will convert one into the other unless you are working with a similar composition and section of casting. Although the author has not completed his investigations on cast irons of large chemical variations and different cooling rates, it appears that high shear test values can be obtained with irons that give low transverse and deflection tests.

Varlet, *Foundry Trade Journal*, Nov. 23, 1922, in his experiment shows the necessity for making test pieces to correspond, so far as is practically possible, with the average thickness of the casting as is now specified in the British Engineering Standards association specification *A* and *C* for gray iron castings. Specimens he had taken from a block of varying thicknesses gave tests that varied from 23.2 to 36.9 kilos in the same casting.

According to Siegle, *Foundry Trade Journal*, Nov. 23, 1922, single shear gives best results. In gray irons, the large flakes of graphite constitute zones of weakness, the effect of which would become exaggerated on bars of small section, the effect would lead to a totally wrong idea of the transverse or tensile test of this iron. Oberhoffer and Ponsger, *Stahl und Eisen*, Aug. 3, 1922, give a striking example of the effect of graphite on bar size. They cut a slice 2.5 inches wide from a 2-foot square block, and cut bars 5, 10, 15, 20 millimeters from this homogeneous piece. The small bar gave no transverse value, the 10 millimeter 25 kilograms, the 15 millimeter 27 kilograms, the 20 millimeter gave 32 kilograms per square kilometer. This has nothing to do with the cooling effect on bars cast of different sizes, but only refers to the effect of graphite on different size bars cut from the same material.

Audo, *Proceedings*, I. B. F., 1926-27, cast bars in cylinders equal in thickness to casting. From these he cut Fremont, transverse and shear tests. He states that the formula is only applicable to stated mixtures. To test the variation that can be met in one casting, the writer cast the block as shown in Fig. 6. In a casting having the variations in section similar to this, it would be difficult for the engineer and foundryman to agree where to take the test pieces to obtain a representative sample, and when one considers the complicated castings that are made, the clauses that would be necessary in a shear test specification to make it workable and also understandable, would be tremendous.

Table III

Shear Relationship to Tensile

SHEAR 0.22-INCH DIAMETER

Bar cast 1-inch square and machined to 0.5-inch diameter bar for tensile test. Tensile test bar later machined and used for shear tests.

Tons tensile	Ratio	Tons Shear
10.5	1.61	17.0
13.5	1.47	20.0
16.5	1.39	23.0
19.4	1.34	26.0
21.3	1.31	28.0

SHEAR 0.5-INCH DIAMETER

Bar cast 1-inch square and machined to 0.5-inch diameter for tensile test. Tensile bar used for shear tests.

Tons tensile	Ratio	Tons Shear
9.5	1.84	17
12.5	1.60	20
15.5	1.47	23
18.5	1.40	26
20.5	1.37	28

These ratios are from the curves plotted from over 150 tests.

Table II

Shear Relation to Tensile and Analysis

Test No.		0.5" Shear Stress. Tons/ sq. in.	0.22" Shear Stress. Tons/ sq. in.	U.T.S. Tons. sq. in.	C.C.	Si.	Mn.	S.	P.	C.C.
1.	.....	16.85	8.17	9.82	0.59	1.56	0.68	0.110	0.64	2.85
2.	.....	22.6	17.6	14	0.56	1.84	0.71	0.103	0.63	2.90
3.	.....	16.25	15.7	10	0.56	1.60	0.65	0.114	0.48	2.90
4.	.....	23.0	20.0	13.85	.....	.....	.....	.....	.....	.....
5.	.....	18.0	16.2	16.7	0.60	1.68	0.65	0.117	0.56	2.75
6.	.....	20.3	20.0	14.3	0.62	1.49	0.66	0.117	0.48	2.75
7.	.....	.....	27.7 }	22	0.66	1.24	0.73	0.117	0.54	2.25
7.	.....	.....	25.5 }	.....	.....	.....	.....	.....	.....	.....
9.	.....	23.6	21.6	16.1	.....	.....	.....	.....	.....	.....
10.	.....	19.95	.....	13.5	0.49	2.03	0.72	0.089	0.86	2.95
11.	.....	25.8	26	17.9	0.58	1.75	0.71	0.117	0.62	2.3
12.	.....	22.9	.....	16.8	0.55	1.82	0.76	0.110	0.61	2.8
13.	.....	21.0	18.8	12.6	0.52	1.87	0.74	0.103	0.78	2.8
14.	.....	18.2	.....	11.4	0.53	2.06	0.74	0.110	0.9	3.1
15.	.....	26.6	25.2	20.4	.....	.....	.....	.....	.....	.....
16.	.....	23.1	22	15.9	0.57	1.91	1.24	0.103	0.76	2.55
17.	.....	27.2	.....	20.4	.....	.....	.....	.....	.....	.....
18.	.....	21.6	20.9	15.5	0.58	1.14	0.72	0.124	0.6	2.65
19.	.....	23.6	.....	15.85	.....	.....	.....	.....	.....	.....
20.	.....	24.2	24.9	18.7	0.63	1.73	1.26	0.131	0.54	2.35
21.	.....	21.6	22.1	14.7	0.56	1.48	0.65	0.120	0.59	3.05
22.	.....	22.6	19.8	13.3	0.62	1.4	0.75	0.113	0.70	2.95
23.	.....	20.4	21.1	13.7	0.62	1.45	0.70	0.110	0.44	2.90
24.	.....	20.7	20.7	13.6	0.58	1.54	0.70	0.110	0.69	2.95
25.	.....	21.7	21.9	13.1	0.55	1.80	0.80	0.110	0.73	2.25
26.	.....	19.2	18.0	12.7	0.62	1.40	0.63	0.120	0.73	2.95
27.	.....	18.8	19.0	12.3	0.62	1.47	0.71	0.117	0.74	2.9
28.	.....	24.7	23.3	16.6	.....	.....	.....	.....	.....	.....
29.	.....	18.8	19.1	12.05	0.58	1.63	0.76	0.117	0.58	2.8
30.	.....	20.4	19.6	14.9	0.53	1.98	0.74	0.110	0.61	2.90
31.	.....	19.0	20.0	13.25	0.62	1.52	0.76	0.117	0.55	3.00
32.	.....	19.8	19.7	13.4	0.62	1.52	0.70	0.110	0.52	2.85
33.	.....	20.3	19.3	13.9	0.60	1.49	0.76	0.117	0.63	2.80
34.	.....	20.0	18.9	13.4	0.63	1.49	0.71	0.113	0.64	2.80
35.	.....	18.6	19.1	18.8	0.58	1.63	0.72	0.116	0.76	2.85
36.	.....	21.8	21.4	15.3	0.53	1.96	0.80	0.093	0.73	2.9
37.	.....	20.1	19.6	13.0	0.53	1.96	0.80	0.093	0.73	2.9
			20.1 from large section of casting							
			20.6 from large section same casting							
			23.1 from small section same casting							
			21.9 from small section same casting							
38.	.....	27.0	26.9	18.1	0.56	1.91	1.20	0.103	0.58	2.80
39.	.....	17.9	18.0	12.2	0.58	1.66	1.76	0.103	0.74	2.90
40.	.....	20.1	18.7	13.7	0.61	1.52	1.80	0.107	0.66	2.75
41.	.....	18.9	19.2	12.5	0.62	1.40	0.77	0.117	0.68	2.80
42.	.....	24.3	23.8	16.4	0.58	1.63	1.25	0.113	0.59	2.80
43.	.....	18.6	16.7	14.4	0.60	1.54	1.03	0.117	0.68	2.7
44.	.....	20.4	18.8	13.9	0.56	1.70	0.76	0.110	0.80	2.80
45.	.....	24.8	24.1	15.9	0.73	1.4	0.72	0.117	0.54	2.25
46.	.....	21.5	20.9	15.2	0.56	1.87	0.68	0.103	0.80	2.85
47.	.....	21.1	19.6	14.5	0.62	1.40	0.78	0.117	0.69	2.80
48.	.....	21.0	19.6	14.4	0.62	1.54	0.76	0.117	0.69	2.85
49.	.....	17.8	17.8	11.3	0.57	1.66	0.77	0.117	0.69	2.85
50.	.....	24.5	23.0	17.65	0.60	1.47	0.76	0.120	0.51	2.75
51.	.....	18.2	16.4	10.9	0.51	1.93	0.76	0.103	0.58	2.90
52.	.....	23.9	22.2	13.7	0.64	1.75	0.92	0.110	0.64	2.2
53.	.....	18.9	18.6	12.3	0.58	1.47	0.79	0.106	0.56	2.80

Bar cast 1-inch square and machines to 0.5-inch diameter for tensile test. Tensile test bar machined later and used for shear tests.

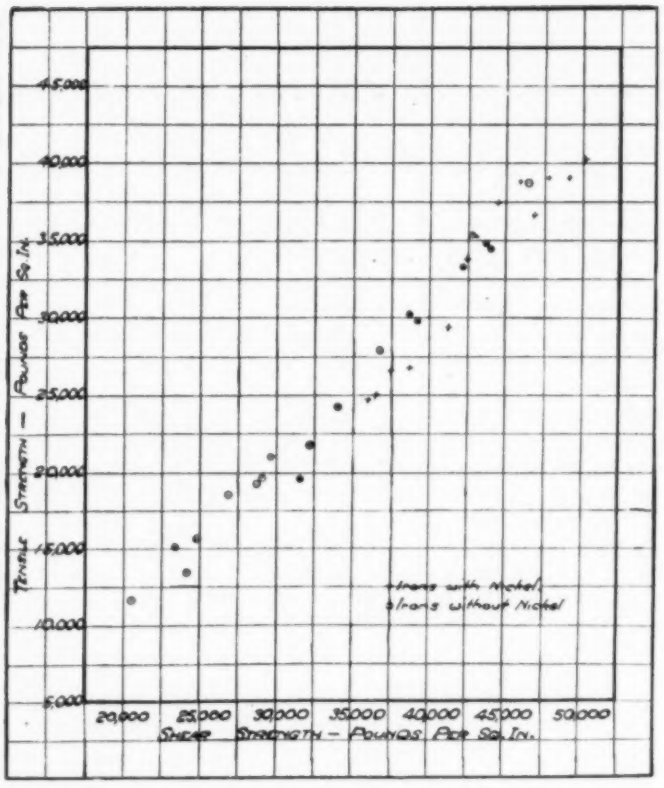


Fig. 5—Chart Showing the Relation of Tensile Strength to Shear Strength as Determined from 0.505-Inch Diameter Test Bars

Table I shows the tensile test results of pieces taken from positions between 1 and 2, 3 and 4, 5 and 6, 7 and 8, in Fig. 6. Without considering the metallurgical points of the governing factors that the structure, size and distribution of the graphite flakes have on the strength of cast iron, it is an accepted fact that generally cast iron which exhibits large coarse flakes is weaker than that with fine curly graphite flakes if other elements remain equal.

Fig. 2 shows the apparatus used for the single shear test and as the sleeves were all ground to size and special self-aligning shackles used in an ordinary testing machine all bending strain and deviation from a true shear was avoided. Fig. 3 shows tensile strengths of over 50 tests plotted against shear tests. This curve is for a 0.5-inch diameter specimen obtained from the broken portion of the 0.5-inch diameter* tensile test piece. Fig. 4 shows a curve plotted on similar lines for the 0.22-inch diameter specimen. These test specimens were obtained from the remaining portion of the 0.5-inch diameter tensile test piece.

Table II shows the chemical analyses of the test pieces. There is not a large variation in the chemical compositions although there is a large variation in the physical results. These are due to the method of producing steel mixtures and cupola conditions. It is understood clearly that although cast irons may have similar chemical analyses the method and materials used in production control its physical properties.

It is the author's opinion that by utilizing the test piece for the shear tests, any variables of structure, etc., are entirely eliminated. Table III shows the shear/tensile ratio for both the 0.5-inch diameter and 0.22-inch diameter tests.

In considering these results it appears that the shear/tensile ratio is inversely proportional, and when the ratio is stated by other investigators it would assist if the lowest and highest tensile tests were stated, as these control the range of the ratios, also the ratios to be quoted as shear/tensile so that various investigators' results can be compared readily and made uniform.

A relation of tensile to shear chart is shown in J. W. Bolton's paper, *Transactions*, A. F. A., 1928, and is reproduced in Fig. 5. This shows a ratio of 1.19 to 1.73. Therefore, it appears that the question of shear test being equal to tensile test for cast iron, as suggested by the originators of the shear test, is not correct, and it is definite that the shear/tensile ratio is not constant for both low tensile and high tensile iron.

We therefore see in the various unetched microstructures of the different sections of the blocks in Fig. 6, a large variation in the graphite size and the weakness of these large graphite flakes on the metal is borne out by the variation in the shear and tensile test results taken at different points.

A general conclusion may be drawn from these notes in regard to tensile

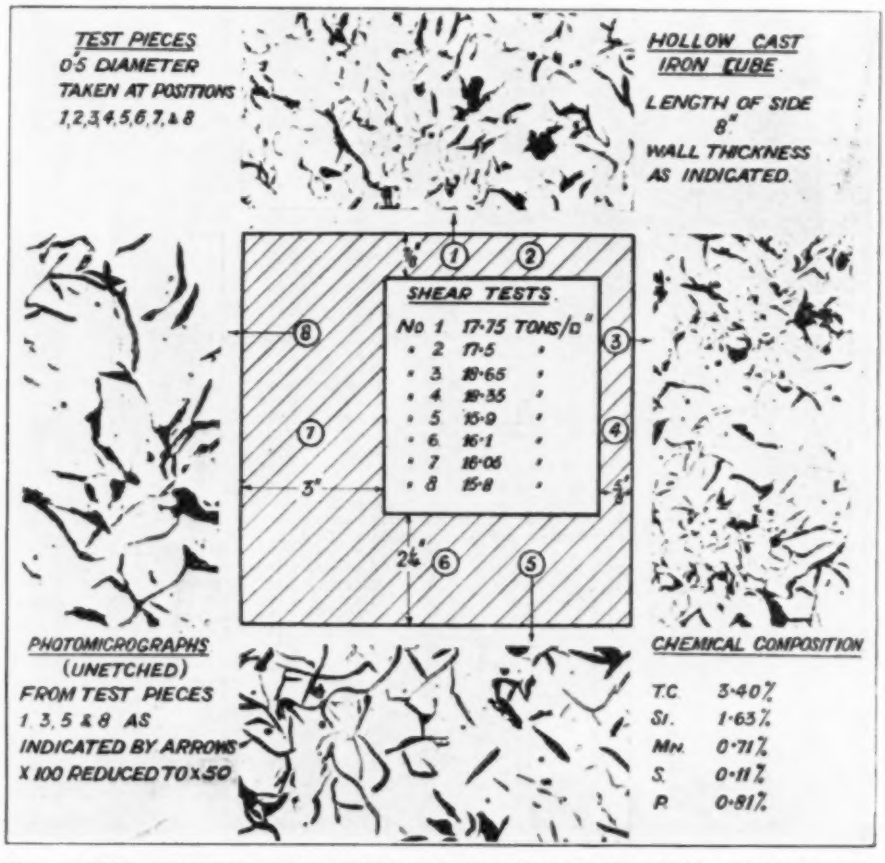


FIG. 6—TEST SPECIMEN MADE WITH VARYING WALL THICKNESS. MICROGRAPHS SHOW STRUCTURE AT THE DIFFERENT SECTIONS

and shear tests. The tensile test, which is a test of the structure of the metal, has been considerably misrepresented. There is no doubt that satisfactory and uniform results can be obtained when the tests are carefully conducted. If the foundryman has a specification that includes transverse, tensile and deflection tests to meet this combination, he is forced to make the castings from a high class metal, and that is what is required by engineers.

The present shear test methods do not appear to give uniform results. Also the shear/tensile results of different investigators vary considerably, which indicates the unreliability of this test. To suggest this as a standard test for cast iron would result in utter confusion as figures put forward for the shear test to represent the tensile test cannot be agreed upon fully. The method of obtaining the test pieces gives a surface that would not be satisfactory for consulting engineers. Also in calculating the results from a trepanned test piece 0.005-inch out of round would not be advantageous to the metal, as the size would be taken at the largest diameter.

Unless satisfactory testing apparatus and test pieces machined true to size are used it appears that it is impossible to avoid a bending strain during testing, which would give false results. No regular relation has been found to exist between shear and transverse tests, but apparently the transverse test is universally accepted as one of the standard tests for cast iron.

The tensile test in conjunction with the transverse, deflection and hardness tests appears to be the most satisfactory method of obtaining the quality and structure of cast iron used for the manufacture of general castings. A small test piece 0.22-inch diameter as suggested for the shear test is out of all proportion for representing the quality of the metal, etc., in castings similar to those shown in another portion of this article.

Publishes Pamphlet

Racine Steel Castings Co., Racine, Wis., has published a booklet on the application and production of basic electric steel castings. The booklet describes and illustrates the facilities for the manufacture as well as many types of the castings that the company makes. It also cites several examples of places where castings have displaced other materials. The Racine company specializes in both plain and alloy steel castings.

New Core Making Methods

(*Concluded from Page 776*)

reinforcing pipes was located on a pin provided for the purpose in the bottom of the corebox. Sand was shoveled and rammed around it by a man armed with a rammer. Satisfactory cores were made in this manner, but too many men and too many coreboxes were required and they occupied too much precious space.

Experiments in jolting the cores did not show favorable results. A sand throwing machine made by Beardsley & Piper, Chicago, was installed to carry on the job. It answered the purpose in every respect with the single exception that the sand did not seem to grip the pipe properly.

Then one day a mute, inglorious Milton unknown to fame stepped forward and said "Why not reverse the usual process? Instead of trying to ram the sand around the pipe why not adopt the machine shop trick of forcing the pipe through a slightly smaller opening in the completed core in the same manner that a shaft is forced into the hub of a wheel?"

The idea was adopted, tried out experimentally and has proved successful. Instead of a hard exterior and a soft center, the cores now are hard in the center and soft on the outside. The difference in density of course is only slight, but the pipe is gripped firmly and supports the core rigidly during the green and drying periods.

Three pneumatic hoists were erected in a row over the conveyor which carries the coreboxes past the sand throwing machine. The rammed core is held momentarily under the first of the group while the plunger pushes two tapered plugs into the sand directly above the centers of the barrels. The second machine forces two tubes into the sand and removes two cylindrical sand cores slightly smaller in diameter than the pipe arbors. The third man inserts the armors in these openings and the third machine forces them all the way down into place. Incidentally these pipes constitute the only reinforcement in the core.

After the core is rolled over and the corebox is removed, a double cap is placed on top of the two barrels to prevent distortion. These caps fit snugly and rest on top of the pipe arbors. They are shown quite clearly in Figs. 2 and 10.

Fig. 2 also shows another feature which shows how nicely every factor must be adjusted and synchronized in the production of large numbers of cores for intricate castings.

At first the entire surface of the core was blackwashed, but the castings showed evidence that the metal was not lying quietly on the cope side. Experiment with blacked and unblacked cores showed that the slight coating of blacking was responsible for the trouble. Experiment also showed that a totally unblacked core produced a rough surface on the drag side of the casting on the inside, but curiously enough, the upper side was smooth. The casting is poured through a gate on the bottom and apparently the hot metal that produced the rough surface on the bottom was sufficiently cooled by the time it reached the top to exert no burning effect on the sand in that part of the core.

Obviously the remedy was to devise a method of blacking the core all over with the exception of the upper surface on the crankcase part. The cores are blacked by immersion on the device shown in Fig. 2. Before the core arrives at this station an operator brushes a light coating of dry talc on the surface which is to remain unblacked. The operator shown to the right in Fig. 2 places the core on a bracket attached to the lower end of an air hoist piston rod. The core is submerged in the blacking bath, then lifted and swung horizontally through an arc of 180 degrees to where a second attendant is waiting to carry it to the core rack suspended from an endless conveyor that carries it through the oven. The talc acts as an insulator and prevents the blacking from adhering to the sand over the talc covered area.

Humane conditions in the cleaning room, the most objectionable department in any foundry, have been improved to a considerable extent in recent years. Originally the cylinder blocks were taken to a floor located above the batteries of tumbling barrels on the ground floor. The cores and arbors were knocked out of the red hot castings and the atmosphere was anything but desirable. The cylinder blocks still receive preliminary cleaning in the same place, but they are taken from the shakeout on the ground floor on conveyor hooks and carried for a journey over the roof where they are reduced to a comfortable temperature before the cleaners start to work on them.

Davies & Thomas Co., Catasauqua, Pa., have purchased the right to manufacture a patented iron by a method known as the perlit process. William Sargent, Newark, N. J., with certain German firms, is licensor of this method of manufacture.

Reduces Costs of Grinding Steel Castings

By F. A. Lorenz Jr.

GRINDING methods in all foundries constantly are undergoing changes as the builders of grinding equipment are redesigning their machines to provide more power, rigidity, bearing and other characteristics which have helped to lower the cost of grinding. In a large measure reductions also have been effected through the progress made by manufacturers of both vitrified and vegetable bonded grinding wheels. It has been a combination of the foundries demanding more efficient operation and lower grinding costs, particularly for alloy steel castings, which has resulted in better design of machines, greater production and improved types of grinding wheels.

Attacks Problem

In a number of steel foundries, the subject of grinding has been given attention from a really scientific engineering viewpoint. Engineers and foundrymen were quick to realize rough steel casting grinding was just as much of a machine operation in the foundry as any other machine operation. Careful study has shown the results to be obtained were largely dependent upon the service to the machine as well as the combined operating characteristics of the machine and the grinding wheel. In other words, to procure efficient operation it was necessary to keep grinding wheels in contact with the work the greatest possible time during working hours. Therefore, the study of service to the machine and to the operator became an important phase of the grinding problem. It was found that good floors for the operator, correctly designed trays, racks, buggies, etc., for bringing the work to and taking from the machines, were necessary.

Without changing the characteristics of the machines or the grinding wheel, it has been found that by just giving the grinder efficient service and bringing the work to him in a properly designed container, giving him continuous work and service enabling him to dispose of the ground castings, the efficiency of the unit has been increased as much as 30 per cent. Of course, it must be realized that this can be possible only in cases where it is practically up to the operator to provide his own source of supply for grinding castings and disposing of them.

Explains Saving

MANY steel foundries have studied the subject of grinding from a really scientific and engineering viewpoint, realizing that rough casting grinding is just as much a machine operation as any other machine operation. One foundry made an extensive investigation of its equipment and, finding its 11 swing-frame grinders to be of obsolete type, replaced them with two modern high-speed grinding machines. The net result was a 66 2/3 per cent reduction in grinding costs with one man producing the work formerly done by five or six operators. How this economy was effected is told in the accompanying article abstracted from a paper presented before the Chicago convention of the American Foundrymen's association. The author is assistant vice president in charge of operations, American Steel Foundries, Chicago.

In approaching the subject of grinding castings, too often the only factor in the situation given consideration has been the grinding wheel itself, when the subject of a comparative service test of various makes and grades of grinding wheels is under discussion. The grain and grade of the wheel often is varied up and down. Grinding wheel manufacturers' experts have been in on the job and they have tried this grain and that grade of wheel. They may have suggested a change of equipment to the foundryman, but too often a deaf ear is turned to these sugestions and the foundries insist on going along with antiquated machinery, inadequate peripheral speeds and wheel changes or speed changes to provide the most efficient cutting speeds. By rearrangement of their department, giving service to modern up-to-date grinding wheel equipment reductions in costs can be made which are truly remarkable and will more than substantiate the cost of the changes.

Questions Layout

The problem should be approached in its entirety. First, the question of layout should be considered.

Is the movement of the work to and from the machines as direct as possible?

Are the types of containers or the layout of the work for the grinders efficient?

Is the grinding unit flexible enough to take care of the class of work to be handled?

Is the operator able to do continuous grinding or is he constantly interrupted?

Are the grinding machines themselves efficient?

Are they under-powered?

Is there proper lighting, heating and ventilation in the cleaning room?

All of these subjects have their influence on the problem. After all of these factors have been considered and a layout determined, which will give the best service possible to the operator of the grinding machines, then the question of the proper type, grain and grade of wheel may properly be considered. When all of these factors are taken in combination and the grinding department properly laid out, or in most cases with the present grinding equipment in the foundries completely revamped, the results which

will be obtained truly are astounding.

In a cleaning department where large castings are chipped and ground, the grinding equipment formerly consisted of 11 swing frame grinders belt-driven from a lineshaft. These grinders were the type which were hung from a side-wall bracket, hinged at the top and in the center, which gave them a limited radius of operation of approximately 2 feet front and back, and 3 feet to either side, and such upward and downward motions as the operator was able to control by his own strength. This type of swing frame grinder was in vogue in foundries 20 years ago, and is continued in many foundries today.

Test Grinding Wheels

In previous tests it had been the custom to take different makes and grades of grinding wheels and compare them one against the other, for pounds of metal removed per contact hour, running them at speeds which the wheel manufacturers and the foundrymen knew were inefficient, but due to physical limitations of the machines, wheel changes were not made at the point to insure efficient grinding. No thought was given to the machine, no thought was given to the time consumed bringing the work to the grinders and then removing it, or the delays occasioned to adjacent grinder operators when work was being placed by overhead crane. The efficiency of the machine, power losses and high maintenance expense due to poor design were lost sight of in the test. The limited radius of action caused many unnecessary movements of work and constant delays to the operators, so the actual contact time of the grinding wheels with the work on an average day showed an efficiency of less than 50 per cent, and in many cases, due to the character of the work, as low as 30 per cent.

The problem of grinding in the particular department was then considered in its entirety and it was decided the 11 swing frame grinders could be dispensed with and replaced with two up-to-date, high-speed grinding machines, which could be hung on a side wall crane, manipulated from the floor and traversing a space 40 by 20 feet. The whole machine was hung so that it had a radius of operation of 360 degrees and an up and down movement of 8 feet. The floor space was all clear. The results of installing the new machine and the handling equipment exceeded the expectations, as one operator is now doing the work with ease which was formerly done with five and sometimes six operators and machines. His work is laid out in such a manner that the only time lost is the time consumed in raising and lowering the grinding machine by a hand-operated chain block or moving from one piece of work to the other by means of the electrically-operated side wall crane.

Work is brought to the grinding wheel and laid out in such a manner that it is most convenient for the operator to grind, with the net result that the grinding cost, taking into consideration cost of wheels, overhead, supervision, power repairs, service, etc., has been reduced to one-third of the former cost. To show the comparative cost of grinding by the old and new methods, the following specific details are given:

	—Best Performance— Old practice	New practice
Average pounds of steel removed per hour	8.8	40.4
Abrasive cost per pound of steel removed	$0.063	$0.059
Labor and overhead per pound of steel removed	$0.106	$0.022
Total cost per pound of steel removed	$0.169	$0.081*

*This is now reduced in actual average practice to $0.070.

Here is a case where the foundry has gone to considerable expense providing new machines, costlier wheels and an extensive crane layout, yet the net results have been to reduce their grinding cost 66 2/3 per cent.

The improvement which has been made in grinding machinery designed for foundries as well as the remarkable strides made in the development of grinding wheels for use on various types and analysis of castings, offers one of the biggest fields for investigation by the foundrymen and others, as the application of the improved methods, machinery and grinding wheels will surely result in one thing —a reduction in cost of cleaning castings when intelligently applied to a particular problem.

In the foregoing tabulation are indicated the best results obtained on the old grinding practice, and composite figure of the results obtained from trials of five makes of grinding machines which were substituted for the old machines. It is important to know the practice was changed from grinding with vitrified wheels, having a maximum speed of 6000 surface feet per minute, to vegetable bonded wheels having a maximum speed of 9000 surface feet per minute. Wheel changes were made at the points indicated in accompanying illustration.

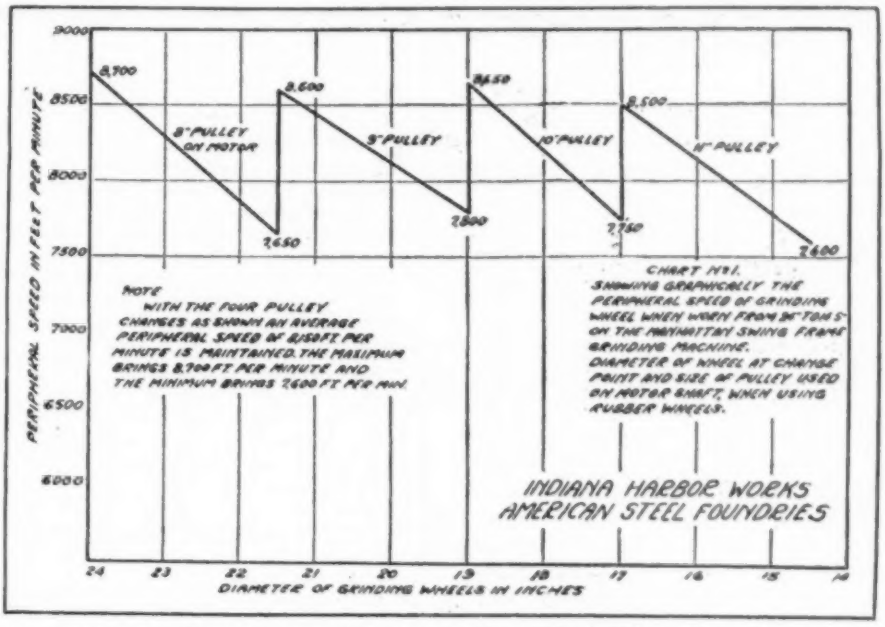

PERIPHERAL SPEED IN FEET PER MINUTE
9000
8500
8000
7500
7000
6500
6000
8,700
8" PULLEY ON MOTOR
7,650
8,600
9" PULLEY
7,800
8,450
10" PULLEY
7,750
8,500
11" PULLEY
7,600
NOTE
WITH THE FOUR PULLEY CHANGES AS SHOWN AN AVERAGE PERIPHERAL SPEED OF 8,150 FT. PER MINUTE IS MAINTAINED. THE MAXIMUM BRINGS 8,700 FT. PER MINUTE AND THE MINIMUM BRINGS 7,600 FT. PER MIN.
CHART NO 1.
SHOWING GRAPHICALLY THE PERIPHERAL SPEED OF GRINDING WHEEL WHEN WORN FROM 24" TO 14½" ON THE NAYMITH 24" SWING FRAME GRINDING MACHINE.
DIAMETER OF WHEEL AT CHANGE POINT AND SIZE OF PULLEY USED ON MOTOR SHAFT, WHEN USING RUBBER WHEELS.
INDIANA HARBOR WORKS
AMERICAN STEEL FOUNDRIES
24 23 22 21 20 19 18 17 16 15 14½
DIAMETER OF GRINDING WHEELS IN INCHES

Chart Showing Peripheral Speed of Grinding Wheel When Worn from 24 to 14½ Inches Diameter on Swing-Frame Grinding Machine; Diameter of Wheel at Change Point and Size of Pulley Used on Motor Shaft When Using Rubber Wheels

In considering the above table, no allowances have been made for the loss of time occasioned by the former practice where five grinders were working close together and were often delayed by placing and removing castings. It will be seen from the figures the average pounds of metal removed per hour are approximately in the ratio of 5 to 1. In other words, one operator now replaces five operators, so that the delays due to placing and removing of work have been reduced to practically a minimum. Under the new method actual total cost of pounds of metal removed is approximately one-half the best practice formerly obtained. Comparing the average cost as shown on the cost sheets, the present grinding costs in the department where tests were made is approximately one-third the former cost of the grinding operation.

Questions & Answers on FOUNDRY PRACTICE

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

STEEL

Limits Carbon Content

QUESTION

Up to what percentage of carbon may the same steel containing 0.65 to 0.85 per cent manganese, with one single heat treatment, attain an elongation not less than 24 per cent in 2 inches, and a reduction in area not less than 35 per cent? How should the heat treatment be performed?

ANSWER

To ensure production of a steel which will give an elongation of 24 per cent in 2 inches and reduction in area of 35 per cent, the maximum carbon content should not exceed 0.30 per cent. Properties mentioned often may be secured with carbon up to 0.35 per cent, but with that proportion of carbon, a number of the heats might not reach the desired figures. These remarks apply to tests made on specimens cut from test coupons. If a single heat treatment is to be used, it should be an annealing at approximately 1650 degrees Fahr. followed by a slow cooling.

Q & A

Boron in Steel

QUESTION

Have you any information on the quantitative estimation of boron in steel? If not, can you tell me where I can find a method of analysis?

ANSWER

The determination of boron in iron and steel requires considerable time and careful manipulation to obtain accurate results. Essentially the method consists in dissolving the steel and precipitating the iron with calcium carbonate. After boiling in a condenser-equipped flask to remove the CO_2, the precipitate is washed on a Buchner filter. The filtrate contains the boron. The boron is titrated with one-tenth normal NaOH or KOH to a pink color. Then 1 gram of mannite is added and titrated again to a second pink color. If the addition of more mannite destroys the pink color the reaction is incomplete. Enough alkali must be added to produce the pink, mannite added, etc.

Owing to the length of the method, we merely have given a bare outline and we suggest that you consult, "Chemical Analysis of Special Steels, Steelmaking Alloys and Graphites," by Johnson, pages 253-56, for the exact procedure.

GENERAL

Plaster Breaks on Machine

QUESTION

We have been using metal patterns mounted on plaster of paris matchplates quite satisfactorily with squeezing machines. Recently we tried the same pattern equipment on jolt machines but we find that the plaster disintegrates rapidly. We have heard that in some American foundries a mixture of sand, litharge and oil is substituted for plaster. We shall appreciate any information you can give us on this or any other material that will make a satisfactory backing for patterns on a jolt machine.

ANSWER

The sand, litharge and oil mixture to which you refer is not quite as substantial as plaster and would be of no use on a jolt machine. It is used quite extensively for making follow boards for light castings such as plumbers supplies, malleable fittings and small stove parts. These castings are made to a great extent on hand squeeze machines and also in plain snap flasks rammed by hand on the bench. For this purpose the sand match gives satisfactory service.

The usual method of mounting patterns to be used in connection with a jolt machine is to make matchplate and pattern from metal. The detail of construction will vary depending on the shape of the pattern, the position of the parting line and whether the pattern is to be lifted out of the mold or stripped through a plate. In some instances the pattern and the plate are cast integral. In others the pattern is cast separately and afterward attached to the plate either by suitable bolts or by welding or brazing.

In the advertising pages of THE FOUNDRY you will find the address of prominent foundry supply houses who are prepared to furnish a proprietary material that is claimed to be superior to either oil sand or plaster of paris for making pattern mounts, matchplates and follow boards. We do not know if they guarantee it against disintegration on a jolt machine.

Q & A

Seacoal Is English Term

QUESTION

In a recent issue of THE FOUNDRY we saw reference to a material known as seacoal which, it was claimed produced a smooth skin on gray iron castings. We shall appreciate futher particulars on this material.

ANSWER

The material referred to in THE FOUNDRY as seacoal is known under several other names locally, but the term seacoal is the one most commonly used among English speaking

foundrymen, both in this country and in the British isles. Other names under which it is known include, ground coal, coal dust, bolted coal, mineral facing. Originally the name was applied to a peculiarly rich gas coal derived from subterranean coal measures in Wales. Old time founders pulverized this coal and added a small quantity to the sand which came into immediate contact with the iron in the mold with a resulting improvement in the appearance of the skin of the casting. It is still used in British foundries. Many foreign founders also insist on using coal from the same district in preference to that found locally or from the coal beds nearer geographically than those in Wales. The first pulverized coal used in American foundries came from Wales and naturally the name seacoal came with it. Later the coal from various American seams was found to be quite equal to the imported variety. It was utilized among other things for making facing material for the foundry, but no effort was made to change the name.

The coal is ground or pulverized to several degrees of fineness depending on the class of castings and the character of the sand in which it is to be mixed. No authoritative opinion ever has been laid down to explain why the presence of finely pulverized coal in the facing creates a smooth skin on a gray iron casting. Some foundrymen claim that the heat of the molten iron deposits a slight coating of carbon on the sand, thus rendering the skin more refractory. Others hold to the view that the gas evolved from the coal forms a slight cushion between the metal and the sand and thus prevents the sand from fusing.

Q & A

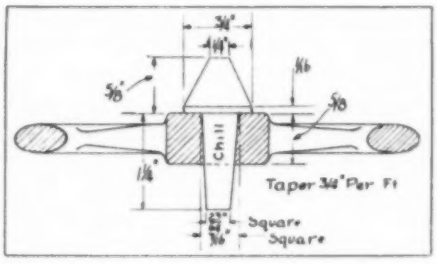
Gives Chill Coatings

QUESTION

We use thousands of hand wheels similar to that shown on the accompanying illustration. In the past we have drilled and broached the square hole in the center, but now we are contemplating the use of the square chill shown on the drawing. What is the best material to coat these chills, to insure smooth holes in the castings and long life for the chills?

ANSWER

Steel chills may be coated with silica flour or foundry blacking mixed with molasses water or any other binding agent to the consistency of cream. The chill is dipped in the material and thoroughly dried in the oven before it is placed in the mold. Cores of this kind find application in many instances, but we doubt if they show any economic advantage in the present instance. They require too much machine work in their preparation. Their life under the best of conditions is comparatively short. If you make them from high carbon tool steel, they will check and crack in a short time. If you make them from a medium or soft steel, you will be faced with a constant mushrooming of the end in forcing them out of the castings. The small taper print will never do. Whether you intend to remove the chill with a tap of a hammer or under a geared device that will exert a steady pressure, the long narrow print will buckle and swell. By casting the wheel with the rivet head print on the drag side and with the tip of



METAL CORE PRESENTS HAZARDS

the core just touching the cope face of the hub, you increase the chance of removing the chill from the casting successfully.

With a taper like that shown on the drawing, the patterns should leave their own green sand cores. If the sand is fine and refractory these holes should require no farther finishing. Dry sand cores made from a fine refractory sand and given a light coating of blackwash could be made to leave a perfectly straight, smooth hole through the wheels. That is if a straight hole is any advantage in fitting over the valve stem.

Chill cores or metal inserts of any kind constitute an additional hazard in that they are apt to condense moisture, which turns to steam and makes blowholes in the vicinity.

MALLEABLE

Heats Over-oxidize

QUESTION

Is there any remedy for a heat that becomes over-oxidized in the air furnace?

ANSWER

It sometimes happens due to a poor lot of fuel, to neglect or to bad judgment on the part of the furnace man that a heat is delayed and an undue amount of silicon, manganese and carbon are eliminated. This may be detected by the sudden stickiness and sluggishness shown by the metal as it is being poured from the test ladle. It also is indicated by the appearance of pin holes at different places on the periphery of the thin rim of the test sprue.

While castings from such a heat when annealed would have a picture frame or an all-steely fracture depending on how badly the metal is oxidized, the heat may be brought back to normal composition by the addition of enough ferrosilicon and ferromanganese to produce a quiet metal and remove the blow holes from the metal. Then add 10 to 20 per cent pig iron and when this is melted and the sprues show a mottled fracture, make a preliminary analysis. Finish as usual. Badly oxidized heats even if restored to normal composition frequently give trouble from misruns, shrinks and cracks .

GRAY IRON

Melt All Scrap Charges

QUESTION

What is the proper tuyere area for a 32-inch cupola melting from 15 to 20 tons a day from all scrap charges? How should the coke and iron be proportioned in the charge? What amount will the cupola melt per hour? How far should the slag hole be located below the tuyeres?

ANSWER

If you are thinking of purchasing a cupola, you safely may leave all the details to the judgment of the cupola manufacturer. Construction of cupolas by the leading makers in recent years has been standardized to the extent that now a customer only need specify his melting needs per hour. Special features are provided to meet unusual conditions. For example the tuyeres on cupolas designed to run long heats are located higher than those on cupolas where the heats do not extend over an hour or two. In many cases minor adjustments and deviations from standard practice must be made to meet local conditions. Variation in the character of the castings, the amount of iron to be collected between taps, the temperature at which the iron must be poured, the quality of the fuel and the tendency of the charge to form slag, are factors which must be taken into consideration. Design of a cupola sometimes is blamed when faulty manipulation really is responsible for unsatisfactory melting conditions.

However, taking your questions in the order they are presented and assuming that you are familiar in a general way with all the foregoing features the following figures cover the inquiries. The proper tuyere area of a 32-inch cupola is about 268 inches which is one-third of the total hori-

zontal area, 804 inches, of the cupola. The circumferential line inside the lining is 113 inches, therefore a continuous tuyere 2½ inches high will present the necessary area. If tuyeres of another shape are preferred they may be used. On short heats the cupola would operate satisfactorily with tuyeres 12 to 20 inches above the bottom. On the long heats you propose you had better set them at least 30 inches above the bottom.

Iron and coke may be charged in the proportion of 1000 pounds of iron to 125 pounds of coke. The slag hole must be located much lower than in ordinary practice, say 12 or 15 inches below the tuyeres and limestone or some other fluxing material must be added freely to keep the cupola clean. The cupola will melt approximately 4 tons per hour.

Q & A

Has High Silicon

QUESTION

A customer of ours is experimenting with a small motor for radio purposes and we are making castings for a couple of sample motors. We believe that some gray iron gives better results than another, and we would like to have information on this point. Our regular run is a machinable gray iron casting made from agricultural cast scrap and some pig iron containing 2.60 per cent silicon; 0.016 per cent sulphur; 0.147 per cent phosphorus and 0.65 per cent manganese.

ANSWER

Electrical castings of the type mentioned should have high magnetic permeability, particularly in the pole pieces. To obtain this feature in cast iron, the graphite should be in the form of temper carbon, with as little combined carbon as possible existing. Free cementite must be absent. These generally do not happen in a gray cast iron unless it is annealed. According to Partridge, *Journal* of the Iron and Steel institute (London), 1928, 1 to 3 per cent aluminum is claimed to increase magnetic permeability.

Therefore, to make the motor frames having the requisite properties you may try using a mixture containing a high silicon so that an analysis may be obtained as follows: Silicon, 2.50 to 3.0 per cent; sulphur, as low as possible; phosphorus, 0.20 to 0.35 per cent, and manganese, 0.50 to 0.60 per cent. You may try annealing the castings which may be somewhat lower than that mentioned. Do not let the silicon get below 2.25 per cent or you may run into chill spots which will not anneal readily. Anneal at 1600 to 1650 degrees Fahr. for one hour. Cool to a black heat in the furnace and then cool in air. A third method is to try the addition of 1 to 3 per cent aluminum.

Q & A

Pulley Has Hard Edge

QUESTION

We are making some pulleys 10 to 30 inches in diameter, 4 to 12-inch face, with a metal thickness of ¼-inch in the face. Some of them machine all right, others machine soft except about ½-inch of the rim at the cope side, and others have hard spots in the face and hard rims. We use 500 pounds of pig iron with the following analysis: Silicon, 2.50 to 2.65 per cent; sulphur, 0.03 to 0.04 per cent; phosphorus, 0.140 to 0.174 per cent, and manganese, 0.69 to 0.96 per cent; 200 pounds of steel scrap, and 500 pounds No. 1 machine and return scrap.

ANSWER

According to our calculations, the silicon in the mixture you now are using runs about 2.00 per cent and the manganese about 0.50 per cent. With the thin face on the pulleys you are making, we believe that the silicon is a little too low. We believe that it should be about 2.25 per cent. It appears from your description that now you are running along the edge, and a slight variation in silicon content will give you hard iron in the rim or face of the pulley. By increasing the pig iron charges to 800 pounds with 200 pounds of scrap you may get the silicon high enough. Possibly you may have to get pig iron containing 2.75 to 3.00 per cent silicon.

Another cause of the hard face may be due to using too much water on the swab just before the pattern is drawn. It is due to carelessness and must be guarded against. This seems to be the cause of your difficulty since the hard spots, according to your statements, appear mostly on the cope side and then only about one-half inch wide.

Q & A

Uses Charcoal Iron

QUESTION

We have received an order which specifies some chilled castings made from charcoal iron. As we have not had any experience with this work, we would like some information. We understand that we should secure some charcoal pig iron and use charcoal instead of coke in the cupola. However, we are not sufficiently clear on the exact procedure.

ANSWER

Charcoal iron contains low silicon and low sulphur, and is melted in the cupola with coke just like any other pig iron. You will have to obtain pig iron with the proper analysis to get the correct chill in the castings to be made. If the castings are large, the silicon will have to be lower than in the case of smaller ones. The temperature at which the iron is poured also will affect the chill depth. The hotter the iron, the greater the chill depth, other conditions being equal. Be sure that the iron chills are clean and dry, otherwise the molten iron will not lay quietly against them. It is a good plan to warm the chills and give them a light coat of oil on the face. Put the chills in the mold warm, and pour as soon as possible. Chills standing in molds for long periods collect condensed moisture from the sand, and blown castings will result.

Q & A

Sulphur Not to Blame

QUESTION

What is the effect of high sulphur on stoveplate castings? What effect if any will it have on castings that are to be enameled?

ANSWER

In past years, sulphur has been blamed for a great many conditions that were caused by other things. It has been shown that sulphur is not as bad as it had been painted—and we have noted in a good many articles that sulphur up to 0.25 per cent does not have any deleterious effect in certain types of castings. However, we would not suggest that this will be satisfactory in every case. Stoveplate, owing to the heat conditions it has to withstand, should not be too high in sulphur, but we believe that if it is kept under 0.10 per cent, no ill effects will be noticed.

However, if other conditions are present—such as oxidized iron, then watch out. Sulphur probably will be blamed, but it is not its fault. We have made a good many steam and water radiator sections which are thin-walled and come under the stoveplate classification, with sulphur as high as 0.12 per cent without having any trouble. This for days at a time.

As far as sulphur and enameling are concerned, we think that the trouble is due to not cleaning the castings properly. The castings must be absolutely clean, otherwise bubbles and blisters will occur. Sandblasting seems to be the prevalent method. If facings of graphite or seacoal are used, they must be removed entirely from the surface as these materials are a prevalent source of blisters. Also we suggest that you write to the superintendent of documents, government printing office, Washington, for the price of the department of commerce pamphlet No. 246 on enameling.

Problems in Nonferrous Founding

By Charles Vickers

Skin Dries Molds

We have a number of bronze tablets to make 25 by 25 inches. As we have no facilities for baking the molds we are obliged to resort to skin-drying and we will appreciate your suggestions in regard to a good facing for this job. Would you recommend plumbago in the molasses water for spraying? The plates are ⅛-inch thick, so it will be necessary to pour the metal quite hot to fill the sharp designs in the ornamental edge.

Some years ago Jacob G. Kasjens, Peoria, Ill., prepared a paper to be presented before the American Foundrymen's association. The subject of this paper was "Casting Bronze Tablets." We are taking the liberty of quoting from this paper, his description of how he prepared his facing sand; as it will answer this question, and in a manner that cannot be improved upon.

"Any good sand that is suitable for other fine brasswork can be used for making tablets. *It should be prepared the day before it is used.* First, put it through a No. 10 sieve, adding about one part of any good core compound, to 40 parts of sand. Sieve again through the same mesh so as to mix thoroughly the compound with the sand, then dampen to the required moisture and sieve through a No. 4 sieve. The sand and compound by this time should be well mixed, and the heap should be covered over at night with well dampened gunny sacks. This will give a strong, mellow mixture which will not require brads to hold the particles of sand between the letters."

In preparing molasses water Mr. Kasjens recommended 1 part molasses to 15 parts of water, which he heated until thoroughly mixed; this he used to spray the mold face before it was skin-dried of course. We do not recommend the mixing of plumbago with the molasses water for spraying. It can do no good, and it is likely to blur the fine impressions. In spraying be careful not to hold the sprayer too near the work as that will obliterate the impression. Avoid spraying to the point of melting down the little hills of sand. After spraying it is advisable to *flour* the mold, blowing off two or three times, guarding against building up the flour in the impressions. After this has been done, let the mold harden for a time, then skin-dry with the torch, until it is toasted a nice uniform brown.

Two happenings to guard against are *ramming away* and *crushing down.* Ramming away is a slip of the layer of facing next the pattern during the ramming of the backing sand. This is discovered after drawing the pattern, and the mold has to be shaken out, as it is no good. It can be prevented by wedging the sand against the flask sides so that it cannot slip. This means ramming around the pattern before going over the face. Some ram the sides first and bank it against the flask, clean off the pattern face, dust with lycopodium, then screen on the facing through a fine sieve, holding the same at a considerable height. Crushing down is a bending of the cope after the mold is closed and usually is done in weighting.

Q & A

Molding Methods Vary

We would like to get a method for casting crown brasses so they will come clean. We have been casting them on end. Some foundries we understand are casting them in forms. Can you tell us what these are?

There are several ways of molding crown brasses. Some mold them on end, some mold them horizontally with the curved back in the cope, using flasks with the end joints shaped to correspond to the curvature of the brass to avoid banking up of sand. We also understand that others prefer to cast them in iron molds pouring them on end, but we have no particulars regarding this method. Obviously those who are using such a method are not going to tell just how it is done, but it seems to be a free and open proposition to anyone who has the time and money to experiment. It is an interesting thing and we will confess we would like to see how it is done, also to inspect the castings. We suggest that the present method of pouring them on end in sand molds be adhered to. Possibly if the castings fail to come clean, the molding sand is at fault. Chances are that it is too fine in grade and that it cuts and scabs. A sand too fine will do that no matter how the mold is gated, whether at top or bottom. Use no sand under a No. 2 Albany grade for such castings, and it must be worked on the dry side for end pouring.

Q & A

Must Not Bend

We have an inquiry for some aluminum channel sections 10 feet long. These castings are to be machined all over and must not bend or warp after machining. Will you kindly give us a mixture suitable for these castings?

We know of no aluminum alloy that we could guarantee against warpage after such a casting as mentioned in the query had been machined. The manner of gating, temperature at which poured and manner of cooling all influence this warping. However, we want to ask; what is the matter with straightening the casting, if it shows a warp after machining, or during the progress of the machine work? The thing to do as we see it is to use a ductile alloy, instead of a brittle one like cast iron; one that will bend back to shape, without breaking. We will mention two alloys. One that is low priced and yet ductile and strong, extensively used in European countries, and another alloy that will bend enough for the purpose outlined, but is less subject to cracking in the mold than other alloys of aluminum. If the first alloy should crack in the case of this casting, use the other one. The first alloy contains 84 per cent pure ingot aluminum; 13 per cent good zinc and 3 per cent copper. This alloy is credited with 30,000 pounds per square tensile and 9 per cent elongation, when made of high grade metals. The second alloy consists of 93 per cent aluminum; 4 per cent copper and 3 per cent silicon.

American Brass Foundry Practice

By Charles Vickers

Part IV—Alloy Compositions Vary

COPPER is the foundation of the majority of the alloys that are used in the production of what are usually known as brass castings. This designation includes all the alloys in general use, many of which are not strictly brasses. and many of them are not bronzes, as their composition includes copper, tin, lead, and zinc, in varying proportions. These red brasses as they are named in foundry parlance, all have a base of copper. Anyone of the three alloying metals, tin, zinc, or lead may preponderate over the others, or they may all be equal in amount, as with the well-known 85-copper; 5-tin; 5-zinc; 5-lead. However, as a general rule it will be found best to have one of the alloying metals in greater proportion than the others. The previously mentioned alloy is no exception as when so modified that the zinc predominates over the tin and the lead, a stronger and more ductile alloy results.

Gives Physical Properties

The average physical properties of copper, 85 per cent; tin, 5 per cent; zinc, 5 per cent; and lead, 5 per cent, range from 27,000 to 33,000 pounds per square inch tensile; 15,000 to 19,000 pounds per square inch yield point; 16 to 20 per cent elongation in 2 inches, and 15 to 20 per cent reduction of area, with a brinell number of 50 to 60. The physical properties of sand-cast tensile test bars of copper, 85 per cent; zinc, 6 per cent; lead, 5 per cent, and tin, 4 per cent as given by R. J. Anderson are as follows: Tensile strength, 36,-800 pounds per square inch; 15,100 pounds per square inch yield point; 30 per cent elongation in 2 inches; 26 per cent reduction in area, and 51 brinell hardness number. While the average physical properties might be somewhat lower than this, the modified alloy in which 1 per cent of expensive tin is replaced by 1 per cent of cheap zinc is just as good as the original 85, 3-fives alloy. Nothing has been sacrificed to economy and the chances are that a better all-around alloy has resulted from the change even though it is small.

Sometimes it is found expedient to have the lead as the leading white metal; the alloy then being changed to 85 per cent copper; 6 per cent lead; 5 per cent zinc, and 4 per cent tin. This alloy loses little in strength by the increase of lead at the expense of the tin. It machines with greater ease, and it is more likely to be pressure-tight than either the original alloy, or the modification with zinc in the leading role. It is a good sand casting alloy. The straight alloys of copper with zinc are yellow within a certain range, and such alloys are well known as yellow brasses, but all alloys of copper and zinc are not yellow. Some of them are a rich gold in color, and this color change is found at both ends of the scale.

The useful alloys of copper and zinc run from a small amount of the latter metal to equal amounts of copper and zinc. Beyond this point the effects of increasing the zinc are to produce a white and brittle alloy, which changes little in appearance over a considerable range of composition. While some of these alloys in which the zinc is in excess of the copper, find commercial application, as a rule they are of little importance in brass foundries, and may be omitted from consideration here. Those copper alloys containing small amounts of zinc, with or without the modifying influence of small amounts of other white metals, are used to a considerable extent in brass founding, and to a still larger extent in brass rolling mills.

Not A True Bronze

Bronze of the rolling industry is an alloy of copper with 10 to 12 per cent zinc, and a similar alloy consisting of 87 per cent copper; 12 per cent zinc, and 1 per cent tin, is used extensively for castings of articles that can be affixed conveniently to other objects by bending over lugs that are a part of the casting. The above formula is an excellent bending alloy. It is stiff, and when polished exhibits a pleasing golden color. It is used extensively for making the clasps attached to travellers' handbags and suitcases, and for any type of casting that is bent to a finished form.

When the percentage of zinc added to the copper amounts only to 1 to 3 per cent, the alloy is called copper both in the brass foundry and the rolling mill. In the brass foundry such admixtures are frequently used and are passed off as copper and for many articles, such as copper hammers, copper soldering bits, such alloys are perfectly satisfactory, and have been used for years. The 50-50 alloy of copper and zinc is known as spelter solder. Its composition may depart from the strictly 50-50 copper and zinc toward the zinc end, or the copper end but usually toward the copper end of the alloy, when, of course, it becomes an alloy having a copper base. Also, other metals, such as nickel or tin may be incorporated in small amount for certain specific purposes, the nickel to whiten the solder, and the tin to lower its melting point. However, the 50-50 copper and zinc may be considered as the standard for spelter solder.

Must Not Fail

Apparently an alloy like spelter solder is a simple proposition. It would be considered so by most foundrymen, and they would use in its composition the sort of copper and zinc they happen to be using in their regular work. For some purposes this might work fine, but for important purposes, it might not. Thus copper piping may be used to carry steam under pressure, and where a failure might mean the sacrifice of human life, the making of spelter solder is not a casual matter to be turned over to an apprentice. There was the case of the steamship failure described by Prof. H. Louis at the annual meeting of the Institute of Metals, Newcastle-on-Tyne, England, in 1911. A brazed joint of a steamship had failed due to the corrosion of the spelter solder used in making the joint. The copper pipe was 5½ inches inside diameter, and at the time of the explosion was under a steam presure of 175 pounds.

The braze was a bevelled joint which extended longitudinally, and

had opened a distance of 3 feet, 6 inches. The joint was found to be corroded badly. The original composition of the solder used to make the joint was found to be 52.68 per cent copper; 46.83 per cent zinc and 0.49 per cent tin. Examination of the damaged part of the pipe showed extensive corrosion of the spelter solder, mainly on the inside of the pipe and analysis showed this corroded portion to contain 78.40 per cent copper; 13.50 per cent zinc; 0.78 per cent tin, and lead, none; oxygen and loss 7.32 per cent, with traces of arsenic, antimony and iron.

An analysis of the sound portion of the solder gave the following results: 66.60 per cent copper; 31.30 per cent zinc; 0.77 per cent tin; 0.40 per cent lead, and traces of arsenic, antimony and iron. It is apparent that even what appeared to be sound metal had lost approximately one-third of its zinc content, and had the corrosion continued it would have reached the composition of the coroded portion given in the first analysis. However, since normal brass of the composition of the corroded metal would have been highly ductile, and therefore, would never have given way as this did, these analyses, while interesting failed to tell the whole story, and it became necessary to resort to microscopical study.

This examination of the solder revealed the crystals of the metal to be separated by a fine network of a white alloy, and it was then found that all the fissures and fractures of the corroded brass followed these lines. These white lines were planes of weakness as they prevented the adhesion of the crystals, so it became important to discover just what caused them to avoid in the future such disastrous occurrences as the bursting of brazed steam carrying pipes.

Caused By Segregation

Experiments were then made with alloys of brazing spelter; one made of pure metals as a control, and others to which were added small amounts of tin, of lead, and of both lead and tin. A careful scientific study of these alloys showed that the white lines of weakness undoubtedly were caused by the segregation of an alloy of lead and tin in the brazing solder. Such an alloy being more fusible than the brass, solidified around the crystals of the metal forming planes of weakness which yielded under strain and permitted the penetration of steam into the solid metal. The steam dissolved out the lead, some zinc and a portion of the tin, resulting in the disintegration of the solder. It was evident that it was the lead that was the injurious element in the solder, the tin appeared to be injurious only in the presence of the lead. The conclusion reached was that the purity of the various metals used in making spelter solder, particularly when it is exposed to the action of salt water, is of great importance.

A high grade spelter solder suitable for marine service should be made from the best electrolytic copper, and the highest grades of zinc. Tin may or may not, be present, but lead should be conspicuous by its absence in such an alloy. The above investigation has been detailed at considerable length because, usually, the results of such work, and the lessons to be learned, therefrom, pass into the literature and in a few years are forgotton entirely, except by the few, who may not be greatly concerned about the manufacture of spelter solder, and the importance of excluding certain impurities from the metals of which it is composed.

Used for Name Plates

To a limited extent this alloy of 50 per cent copper and 50 per cent zinc is used for casting purposes. Sperry recommends it as a cheap alloy suitable for certain kinds of name plates. He suggests the addition of 2 ounces of aluminum to each 100 pounds of the alloy, as without the aluminum it cannot be cast in sand molds. He further states that the alloy is as strong as cast iron, and that while it is a hard metal owing to the fact that it does not clog the tools, it can be drilled without difficulty. It casts soundly and without pinholes, and its color is orange.

A similar alloy but slightly lower in zinc, containing 55 per cent copper and 45 per cent zinc has been used by the author for the casting of plaques, as described in the January, 1911 issue of THE FOUNDRY. This alloy is hard enough so that the castings can be tumbled to a bright finish, which, after being lacquered is quite permanent. The casting illustrated in the article is still in service as an ornamental plaque, after 19 years service. The tumbling burnishes the high lights and so forms a pleasing contrast to the natural sand-cast surface, the color of which is a soft yellow gold. In making such alloys for casting purposes it is advisable to hold them in the furnace at the temperature at which the zinc flares strongly for a few minutes and then add solid metal to cool down the alloy to the point at which the zinc smoke comes off freely in the furnace, but flares only after removal when the surface of the liquid metal is disturbed by the skimmer. This applies to all high zinc alloys without exception.

The regular use to which spelter solder is put, as its name implies is for brazing purposes. The alloy known as brazing metal is entirely different from spelter solder, or brazing solder as it is sometimes called. Brazing metal is an alloy of comparatively high melting point. It is used largely for making the cast parts of coppersmith work, such as flanges, which are permanently affixed to copper piping to afford the means of bolting the various sections of the latter together. The spelter solder is used in brazing these connections and its melting point must be lower than that of the objects to be brazed; the copper of the body of the pipe, and the alloyed metal of the flanges.

Brazing metal is usually a copper-zinc alloy, the composition of which may vary slightly, but an excellent formula is the following: 86.50 per cent copper; 12.50 per cent zinc, and 1 per cent lead. The small amount of lead in the formula is added to improve the machining qualities of the metal, as these flanges are faced off in the lathe, are bored out, and numerous bolt holes have to be drilled. Sometimes an alloy of 90 per cent copper, 10 per cent zinc is used, but the first alloy given is to be preferred for most of the work of the coppersmith.

Place Sleeve Up

Flange castings consist of a short sleeve carrying a comparatively heavy flange, and they may vary in diameter within a considerable range. A peculiarity of the alloy is that it is tender at the congealing point. For this reason the easiest method of molding is not the wisest, as the flange may separate from the sleeve part, thus forming a deep crack at the point of junction of the two bodies. The easiest manner in which to mold such an object is with the flange up. However, the thin sleeve part will congeal before the flange and then drop away to the extent of its shrinkage from the flange. Thus we get a crack, sometimes of considerable width, where the two parts join.

The safest way in which to mold such a casting in this kind of alloy is with the flange downward, coping off the sleeve part, and taking off stiff vents from the top or thickness of the sleeve, through the cope. In this position the pull of gravity favors holding the two parts together, instead of tending to separate them. The vents through the cope should be made with a thick knitting needle to relieve the air pressure against the rising liquid metal as it fills the mold.

The vents also carry off the zinc smoke, of which a 10 per cent zinc-copper alloy will give off considerable provided it has been deoxidized, as it should be, by the addition of about one ounce of 15 per cent phosphor copper to each 100 pounds of alloy. Too much phosphorus should be guarded against. It should be reduced when the zinc smoke produces flakes in the atmosphere, something like a miniature blizzard. The amount given above however, will be found nearly correct.

Roll Mold Twice

Sometimes patterns for flanges are constructed merely with the ordinary draft on the sleeve part, the pattern-maker assuming they will be molded with the flange in the cope. In instances of ill-advised pattern work it is not commercially possible to cope off the sleeve, because the latter is too straight to favor a lift and the mold would be torn while lifting off the cope. In such situations the mold still can be poured with the flange downward if it is rolled twice and two partings are made on the core; one at the top, and the other at the bottom, the mold being made as though the flange was going to be cast with the flange part upward.

After the mold is rammed fully, the drag half is lifted off like a cope, leaving the entire pattern in the other half of the mold. The sprue is punched through, provided it has not been rammed up with this half of the mold, and the gate is cut, usually into the circumference of the flange. The pattern is drawn after the usual preliminaries of painting around it with water, and rapping. The flat drag next is closed to place and the entire mold is rolled over and the cope is lifted off, this time leaving the core on the drag of the mold. If the cope has been made in the pin half of the flask it can be set on its pins on the floor to await the finishing touches on the drag, and to permit reaming out the sprue head.

To prevent the core shifting during the mold rolling over, after the pattern has been withdrawn, the core partings are made concave, both at the top and at the bottom. Drag and cope partings of the core, thus carry a hump which fits perfectly the hollows of the core and serve to anchor it in place. If some such scheme is not thought of in ramming the mold, the chances are excellent for the shifting of the core as the mold is rolled over. Rolling over itself should be done quickly and it had best be done by two men. This method requires a little more molding time, as will be expected, than in cases where the pattern is made with a view of casting the flange part down and in the drag of the mold, and coping off the sleeve. It produces the same results as the latter in that cracking or shrinking is prevented.

It is seldom that such castings are called for in numbers sufficient to justify adaptation to machine molding, so they generally are made by hand, but there is no reason why they cannot be made on machines whenever it will pay to do so and in case this happens the patterns should be adapted for molding and casting the flange part in the drag as this method will insure the highest percentage of good castings.

Brazing metal is not a yellow brass, although it is a copper-zinc alloy, and as such belongs to the yellow brass family. Its color is gold with a copperish tint when it is polished, but it is too soft for many purposes and when used as a red brass, as is frequently the case, tin is added to stiffen it, as shown by the baggage clasp alloy previously mentioned. Another alloy of this type but considerably stiffer contains 86 per cent copper; 10.50 per cent zinc; 2.50 per cent tin, and 1 per cent lead. The color of this alloy is deep gold, inclined to the copper tint, and it has been used extensively for highly polished castings to be chromium plated. This alloy has given excellent results where the castings are small and can be poured with gates that permit choking, so the sprues can be kept filled until the mold is cast.

Produces Debris

In the case of large castings where considerable surface must be polished it is almost impossible to use it, and maintain normal production losses. This is because of its comparatively high zinc content, which after the metal has been properly deoxidized, produces considerable amounts of floating debris, which is constantly arising to the surface of the pot or ladle. This material is difficult to skim back in pouring so that it will not enter the mold with the stream of metal, producing defects not observable until after the object has been cut down and polished. Even when it is feasible to use choke gates, or skimming gates that float back this debris, the clean metal will distill zinc as it slowly enters the mold. The nascent zinc coming into contact with the air in the mold produces zinc oxide fumes, within the mold itself which are condensed on certain parts of the cool cope in fluffy strings and detached woolly masses producing serious defects in the case of castings.

For these reasons a brass of the type where the zinc is in excess of the other alloying metals is unsuited for such castings as have just been considered. The alloy possesses one rather valuable property in that it can be welded nicely with the acetylene torch. Castings of extensive size can be cast in two or more parts, and afterward welded to a solid whole, thus permitting greater production in cases where if cast entire, the mold would be too cumbersome to obtain a satisfying production of castings. This advantage, however, may be offset by the disadvantages enumerated in the case of castings requiring a high finish. For such work an alloy in which the tin predominates over the rest of the white metals in the alloy, will give much better results from a production standpoint.

Gray Iron Institute To Meet Oct. 16

The annual meeting of the Gray Iron institute will be held Wednesday, Oct. 16, at the Hotel Cleveland, Cleveland. The entire day and evening of that date will be devoted to institute affairs. The morning program will include reports of officers and committees covering detailed business activities of the institute. A number of authorities on industrial affairs will address the afternoon session. Among these will be R. R. Cunningham, National Sales Development Service, Cleveland, who has served various trade associations in outlining plans and practices. Another speaker will be T. M. Harrison, Stevenson, Harrison & Jordan, New York. A discussion on wage incentives and bonus plans in the relation to costs and prices, will be of interest to the members and visiting foundrymen. All will be welcome at the meetings, luncheon and dinner.

The annual dinner will be held Wednesday evening and a special surprise feature is promised by A. J. Tuscany, manager.

The two days previous to the convention, Oct. 14 and 15, will be devoted to meetings of various committees of the institute and of the board of directors.

At the annual election to be held Oct. 16, five directors will be elected, each to serve a three-year term.

Joins Chain Belt Staff

Robert B. Marshall, for the past 21 years connected with the conveyor business, has joined the staff of the Chain Belt Co., Milwaukee, with headquarters at the New York office, 50 Church street.

Use Special Flasks

To Make

Telephone Pay Station Castings

By Herbert R. Simonds

WHENEVER a person uses a pay telephone, it is probable that the coin is caught and safeguarded in a gray iron casting. Attempts to make pay telephone boxes of other materials so far have been unsatisfactory. A large portion of the pay telephone apparatus now used in the country is made by the Gray Telephone Pay Station Co., Hartford, Conn., in co-operation with the Western Electric Co., Chicago.

Castings for the Hartford company are made at several foundries in central Connecticut. One of these foundries recently secured a large contract because of the fine finish and workmanship on the castings it supplied and the company promptly prepared for production work. The first step was to secure efficient pattern equipment. The design of the casting is far from simple, and many foundries have been unsuccessful in turning out a satisfactory job on a production basis.

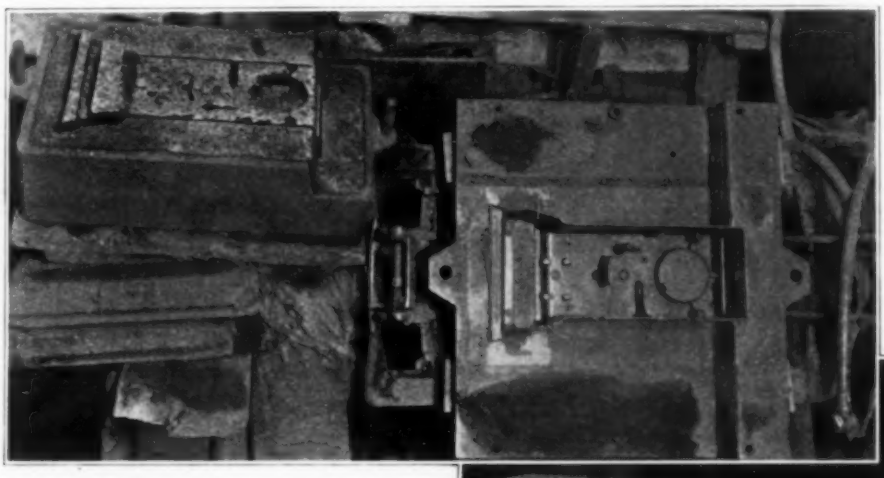
The plate shown in Fig. 1 was designed after some study. It was found advisable to break the mold at or near the front flat surface because of the many lugs and projections on the interior of the box or front portion of the casting. That method places the entire pattern in the drag. One objection to that method was the beveled surface on the end face which would prevent a straight draw without using a core. To avoid that and still keep the break at the front of the casting, an offset plate with special flask equipment was provided.

Fig. 1 shows the drag after it had been withdrawn from the drag plate. The beveled surface is shown at the right. The gating, which is somewhat unusual, also is designed to avoid cores and to give a uniform flow of metal to both sides of the casting. The cope plate and the cope mold are illustrated in Fig. 2.

The molding equipment for producing the casting consists of a squeeze type molding machine and a rollover pattern draw machine. The former is used to make the copes and the latter for the drags. One man handles the job and produces approximately 100 castings per day. The flasks used on this job are specially made castings with machined centering pins and holes.

The molder works for approximately an hour making drag molds and placing these along his floor in an orderly manner. He then shifts to the squeeze machine and works until he has made enough cope molds to cover the drags. After covering the first batch of drags with their copes, he returns to the drag machine and again goes through the same cycle of operations. The method of operation was left to the molder's choice and was adopted to give him a change and rest, and to avoid having too large a number of uncovered drag molds on the floor.

After the molder has completed the day's molding, the hot iron is brought from the cupola to his floor and poured into his individual ladle. He pours his own molds, weighing and pouring every third mold, then shifting weights, one mold to the right



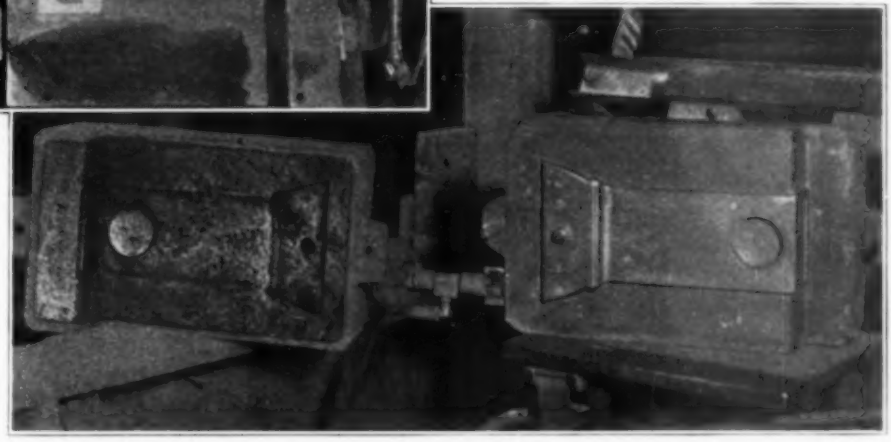


FIG. 1—(ABOVE)—THE MOST INTRICATE PART OF THE CASTING IS IN THE DRAG HALF OF THE MOLD. FIG. 2—(RIGHT)—COPES ARE MADE ON SQUEEZE TYPE MOLDING MACHINES

or left for the next ladle of iron. The casting is shown as it was taken from the sand in Fig. 3. This shows clearly the design of the gate. The metal flows in at the open side of the box-like casting. The gate is cut off on a continuation of the lower line of the opening as shown in the illustration.

Sandblast equipment, made by the Pangborn Corp., Hagerstown, Md., is provided for cleaning these castings. Specifications call for a sufficiently smooth finish to take a coating of enamel without polishing, and this means that the utmost care must be exercised in the preparation of the mold. Iron of the right quality and temperature must be provided and the castings must be cleaned thoroughly. The castings are thin walled. Castings which are warped and have shrinkage cracks cannot be used.

The machining operation is an elaborate and specialized process. For example, one operation consists of mounting the casting in a jig on a machine that has four movable drill heads, each head containing from 3 to 12 drills of various sizes and operating at different speeds. These four heads moving simultaneously from four different directions, drill all of the holes called for in the work of machining and assembling in one operation. The casting must conform closely to specified dimensions to have the indexing of these holes accurate.

FIG. 3—THE CASTING IS GATED BY EXTENDING THE SIDES OF THE BOX TO THE RUNNER

Equipment Industry Has Prosperous Outlook

The continued excellent business conditions in the foundry machinery field for the remainder of this year was predicted at the forty-eighth meeting of the Foundry Equipment Manufacturers association which was held at the Hotel Van Curler, Schenectady, N. Y., Aug. 29 and 30. It was pointed out that the index of gross orders for foundry equipment for the month of July, 219.3 was the highest since August, 1928.

Reports were presented at the meeting by S. T. Johnston, S. Obermayer Co., Chicago; M. J. Evans, Whiting Corp., Harvey, Ill., and H. Cole Estep, secretary-treasurer of the F. E. M. A., covering opportunities in Europe for the promotion of export trade in American foundry equipment, based on observations at the recent International Foundrymen's congress in London. H. W. Standart, Northern Engineering Works, Detroit, president of the association, presided at the meetings.

E. O. Shreve head of the industrial division of the General Electric Co., and J. P. Jones, manager of machinery sales of the General Electric Co., entertained the visiting delegates during the meeting. An inspection tour of the General Electric Research Laboratories took place Friday morning, followed by luncheon at the General Electric works, at which Mr. Shreve discussed the sales problems of machinery manufacturers.

At the association's luncheon Thursday, Aug. 29, Dr. A. W. Hull, assistant research director, General Electric Co., outlined some of the research problems now confronting the General Electric organization with special reference to the application of vacuum tubes to the control of power circuits.

The members of the association presented past president S. C. Vessy of the W. W. Sly Mfg. Co., Cleveland, a golf bag in recognition of his services to the organization.

An enjoyable tournament was held at the Mohawk Golf club.

The next meeting will be held in New York City, Nov. 19 of this year.

FIG. 4—(LEFT) MOLDER POURS HIS OWN MOLDS. FIG. 5—(ABOVE) CASTINGS ARE CLEANED THOROUGHLY BEFORE BEING PAINTED AND FINISHED

The FOUNDRY Family Photograph Album

Upper Left

W. L. BELKNAP

Belknap Mfg. Co., Bridgeport, Conn.

Lower Left

H. D. HARVEY

Monarch Engineering & Mfg. Co., Baltimore, Md.

Upper Right

GEORGE BATTY

Steel Castings Development Bureau, Philadelphia

Lower Right

H. E. FIELD

Wheeling Mold & Foundry Co., Wheeling, W. Va.

ALUMINUM BRONZE DATA

(*Continued from Data Sheet No.* 780)

Precisely analogous conditions obtain in the case of the modified silicon alloys, in which there is a similarly abrupt change from liquid to solid. No founder who has experience with this light alloy need fear trouble with aluminum bronze. For the remedy is the same in both cases, and consists simply in arranging that some portion of the casting which will not be wanted subsequently freezes last and takes the consequent shrinkage.

Use risers freely over such danger points, and so fix their design and section that they do in fact freeze well after the casting to which they are attached.

Founders of the light alloys of aluminum seldom find undue difficulty in obtaining solid castings in aluminum bronze, because their whole training is in the direction of providing a prolific array of risers. If the same risers are used for aluminum bronze they will generally be found ample, but they also will be found far more costly to remove. If the same sort of risers are used as would be provided in ordinary brass founding, the cleaning room charges will be correspondingly reduced, but the castings will probably have many internal cavities or draws. What is needed for aluminum bronze, therefore, is a wise compromise between the technical value of the former and the economy of the latter.

When placing heavy risers, however, bear well in mind the tendency of this metal toward self-annealing, and the influence of a heavy riser in checking rapid cooling. It may be advisable in many cases to chill a section heavily, not instead of using a riser, but because a riser is there and may retard cooling sufficiently to set up a self-annealing. The intelligent chilling of a section to which a riser is attached does at any rate ensure that the riser itself will freeze last, and that is a point in itself which calls for close attention where bottom pouring is used, and metal which reaches risers is often at a rather lower temperature than the metal in the casting.

Many devices are used for insuring that a riser is doing its duty as a feeder up to the last moment, and one of these consists in placing tall headers over the risers proper. When the mold is full, the gate is covered quickly with sand and a lump of pig iron, and the headers then are filled gently with hot metal.

Where isolated heavy sections occur in such a position that risers would be difficult to remove in so tough a material, then the remedy is heavy chilling, to force such sections to freeze within the same time, or preferably slightly before, the light sections in the vicinity.

In view of the self-annealing propensities of aluminum bronze, the more chills used the better. The ideal for the 10 per cent bronze is a

(*Concluded on Data Sheet No.* 782)

ALUMINUM BRONZE DATA

(*Concluded from Data Sheet No.* 781)

chill mold throughout, but in the majority of cases this is an uneconomical proposition, and here again the founder must be left to steer a course between technical ideals and practical economics. In sections below 1-inch thick cooling in the normal sand mold is sufficiently rapid to avoid self-annealing, but in the case of abrupt changes in section or isolated bosses, the same rules apply here as in other foundry materials. The only difference is that they apply more definitely in the case of aluminum bronze. It is well to remember that it is difficult to provide too many chills for this material, and that normal foundry troubles associated with abrupt change of section and unequal freezing are accentuated in the case of these high tensile bronzes.

Tensile strength of aluminum bronze, and its elongation factor, are so high immediately on freezing and from thence to room temperature, that no defects such as cracking are likely to be caused by leaving in the mold until it is convenient to shake out.

Castings 1-inch in section and upwards, however, are often saved from self-annealing by shaking out as soon as possible after solidification and allowing to cool off in air. Quite heavy castings can be turned out without any self-annealing symptoms if they are shaken out quickly and sprayed with a fine spray of water, but this operation calls for a certain amount of judgment and experience. It is quite comparable with the hardening of steel, and aluminum bronze castings are quite as sensitive. The hardness obtained by this method may be worse for the founder's purposes than a slight tendency to self-annealing, and the degree of hardness is likely to vary from one casting to another with variation in the degree of quenching.

Original properties of self-annealed castings may be restored by heating the casting to a temperature of 850 degrees Cent. (1562 degrees Fahr.) and quench without delay between furnace and quenching bath. It is only necessary to heat long enough for the whole structure to attain a temperature between 850 and 900 degrees Cent. (1562 to 1652 degrees Fahr.)

The correct metallurgical structure now will be restored, but with a certain loss in ductility and gain in hardness. Internal stresses also may have been set up in intricate work, and a further simple annealing operation will remove these.

If the maximum brinell hardness is required in the casting, reheat only to 400 degrees Cent. (752 degrees Fahr.) If maximum tensile properties are wanted, reheat to between 625 and 650 degrees Cent. (1157 to 1202 degrees Fahr.)

In many cases in practice it may be found more economical to allow a casting to self-anneal and to heat treat as a matter of routine afterwards, rather than provide a costly set of chills in cases where only one or two castings are required from a given pattern.

THE FOUNDRY DATA SHEET, SEPT. 15, 1929
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Bill Offers Advice on Bed Frame Castings

By Pat Dwyer

WHILE jaunting around hither and yon a few weeks ago the party stopped for a day in Chicago. Stopped is not exactly the proper word. We remained for a day in the city, but the majority of the party seemed to think the day would be wasted unless they walked through every mercantile establishment inside the Loop. Considering the fact that mercantile establishments are the same in every city of consequence and that the goods on display bear a striking similarity to those in the old home town, I could not work up any enthusiasm over the program.

I plodded around in the rear—quite in the rear—until lunch time and then I put both feet down flat and boldly declared I was through for the day. My vanity was slightly ruffled when I found that this manly declaration was received with only the slightest degree of interest. The other members of the party were too ladylike to give three rousing cheers, but in a general way I gathered that my absence would not throw any wet blanket over their further activities.

They did not even ask how I proposed spending my time, probably owing to the fact that in their vocabulary the words *spending* and *time* never are associated. Time apparently conveys absolutely nothing to their minds, but spending—Ah! Spending! There is the most magical word in the English language. It is among the first, if not actually the first word the dear little tots learn at their mother's knee. It is the lode star and guide in the early formative and adult years. It is a consolation and comfort while going down the far side of the hill of life. The inability to indulge in further spending constitutes the chief if not the only regret when the dark angel appears and imperiously beckons: Come. We agreed on a mutual meeting place about 6 of the clock and then they started away blithely. I filled a pipe and spent a quiet hour roosting comfortably in an exceedingly well upholstered chair in the hotel lobby. No one bothered me asking silly questions or in seeking my opinion on the burning questions of the day. I spent the greater part of the hour idly speculating on a question that has engaged my attention in other occasional idle hours over a considerable period.

Up to the present, I regret to say, I have failed to find the answer. Perhaps by presenting it now, some friendly reader will come forward with the solution. In the words of the immortal—or infamous—depending on the point of view—Brutus: Friends, Romans, countrymen, lend me your ears, etc.

How do you account for the fact that a woman can remain on her feet and walk approximately 20 miles through stuffy stores in a 10-hour shopping expedition, when the same woman would drop dead from exhaustion if forced to walk 1½ miles in a straightaway?

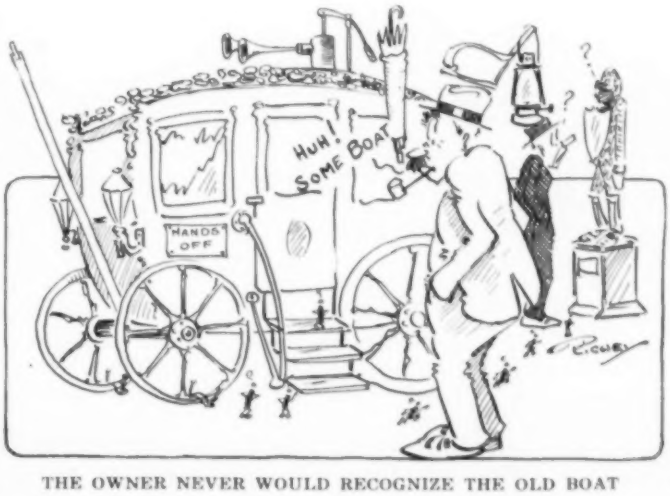
Candor compels me to admit that I never have seen one who actually *did* drop dead under these circumstances, but that is because no one ever has tried such a feat of endurance. On the few occasions I have proposed a measure of this kind to a certain lady she has called on high heaven to witness that it would be the death of her. Furthermore, she has intimated that no person except a thoroughly heartless villain would suggest such a cruel method of getting rid of his consort.

My innocent and well meant explanation that the exercise would do her good has been met coldly by the remark that she is not the member of the family who needs exercise.

The question, gentlemen, now is open for discussion. The chair will be pleased to receive pertinent suggestions on the subject.

In the meantime let us consider the further activities of the energetic tourist we left sitting comfortably in the lobby chair. In all probability you are betting 10 to 1 that he fell asleep. Let this be a warning to you to shun the insidious vice of gambling. You would lose your money.

As the crow flies, I estimated the distance from the hotel entrance to the Field museum at about half a mile. Unfortunately, I am not equipped with a pair of heavy black wings, therefore I had to take a slightly more circuitous route. The sight of several taxicabs at the curb with drivers lolling easily in their seats imposed a severe strain on my iron resolution to walk the entire distance, but I am happy to say I resisted the temptation manfully. The glow of satisfaction I experienced at the end of the journey may be attributed in part to the sense of moral victory and partly—I am afraid—to the fact that the thermometer showed a temperature of 94 degrees at various points where I consulted these instruments



THE OWNER NEVER WOULD RECOGNIZE THE OLD BOAT

along the Boul' Mich. I did not examine them closely, but I am inclined to the opinion that they were of the Centigrade variety.

The atmosphere inside the building, particularly after I had removed my coat, was quite tolerable and I spent several delightful hours rambling around in the quiet and peaceful halls. 'Tis a great place to meditate on the marvels of the earth, sea and sky, past and present and to note how the men of many lands during their brief span of existence have obeyed the creative impulse in fashioning objects of beauty and utility.

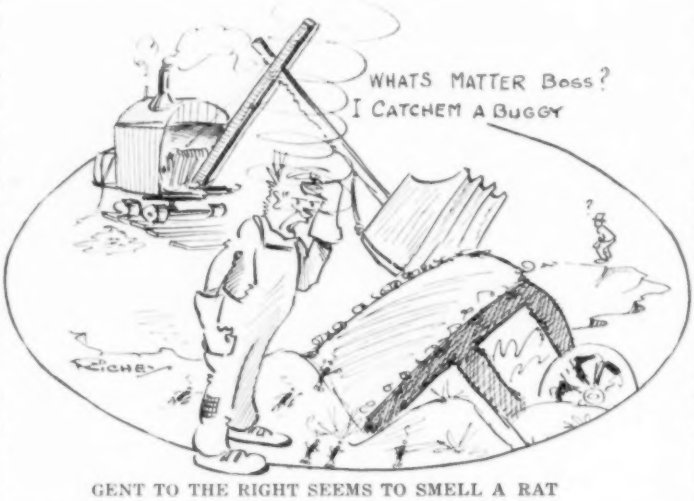
The remains of an old Roman all metal chariot bridged the gap of centuries and led me to speculate, idly, on the identity of the highly skilled craftsmen who had fabricated it with the meager facilities at their disposal. The man or men who handled the job, hammered each piece laboriously into shape and then joined them cunningly, to produce a masterpiece. On a bright and shining morning, say about the middle of July A. D., 2 or 3, it was delivered to the owner at his palatial villa on one of the seven hills. A pair of spirited horses was attached. J. Henry Flavius stepped aboard, feet spread wide apart and knees braced against the dashboard. With the reins firmly grasped in a pair of sinewy hands and with his toga streaming gallantly from his shoulders, he swung the chariot down the graveled drive, out through the gate on one wheel and then giving the horses their heads he tore down the Appian Way as if the devil was at his tail with a red hot pitch fork dipped in brimstone and sulphuric acid.

Foregathering with other sporty lads at one of the convenient road houses, he modestly accepted admiring comments on the new model. With a flagon of exhilerator in one hand, he pointed with the other to the wheel base, the new high back, the special axles, the curved dash and to the shock absorbers for the feet and knees.

Special attention was directed to a beautiful ivory and onyx pocket attached to the inside of the dash near the upper right corner. He explained this was the receptacle for the butt of the accelerator, a long whip employed when he wanted to coax a little more speed out of the motive unit.

Nonchalantly he assured all and sundry that up to the present he had not attempted to push the old can up to a speed of over a mile in 3 minutes, but after the bearings were broken in properly and running sweetly he expected to be able to negotiate the mile in 2:40. On a good track or a decent stretch of road he could do better, but you know how it is; with a rotten political administration and grafting road contractors there isn't a proper street in the city. Something should be done about it. Grave and eloquent nods from the other gentlemen endorsed these noble sentiments and another flagon all around was spilled to the toast *happy days*.

Maker, owner, companions and horses long since have been reduced to a common level as they moldered into silent dust. Who knows how many men in succession made a down payment and paid a few installments on the interesting old relic while it was in a negotiable condition. Probably it ran through the usual gamut of ownership, rich man, poor man, beggar man and thief. The last owner wrecked it while making a getaway from a stick-up job in the temple of Mammon and on the following morning it was picked up by a thrifty junk dealer making the rounds after the "rags and the bones and the bottles today."



GENT TO THE RIGHT SEEMS TO SMELL A RAT

Lacking a buyer, the chariot remained in the yard year after year. Gradually it had sunk in the ground and had been covered over with the flotsam and jetsam that accumulates in every junk yard. Eventually, the junk man died and the yard was converted into a parking space. It was graded and leveled and the old chariot was covered under a layer of cinders.

There it remained snug and warm while the days and nights followed each other in single file to be checked off in monthly companies by the old man in the moon. Months were mobilized into yearly units and the years became links in the chain of centuries that connect the past with the present.

One fine morning in link No. 20, Tony Mallala, expert steam shovel operator for the Imperial Construction Co. Inc., grasped the control levers in his highly capable hands and proceeded to dig a mighty hole on the site of the old junk yard. Whistling jets of steam punctuated each noble effort as Tony dropped his scoop, filled it with material and then with a skilful manipulation of three levers, raised it aloft, swung it in a graceful arc and discharged the material into a waiting truck. An artist to his finger tips, Mr. Mallala could judge his distances and clearances to a fraction of an inch. In fact he was wont to remark modestly that he could hold her within tolerances of a cat hair. When his experienced eye landed on the foreign body in the side of the excavation, he gently insinuated the prongs of the scoop under it. About 23 seconds later the old chariot was lying on the bank and Tony volubly was dickering with "da bigga da boss" for a modest share of the salvage. Eventually it (the chariot, not the salvage) found its way into the Field museum in Chicago. One night recently I submitted this theory to Bill and intimated that I thought it was pretty clever for a fellow of my size to think up all by myself. He did not appear to be unduly impressed.

"The chariot probably is a couple of thousand years old," he admitted. "but all the rest of the story conjured up in your fertile imagination is just a mess of baloney. My own private opinion is that the thing, carefully covered with an old tarpaulin in the back woodshed, has been handed down from father to son through long generations, until an antiquarian with a sufficiently long purse came along and secured it.

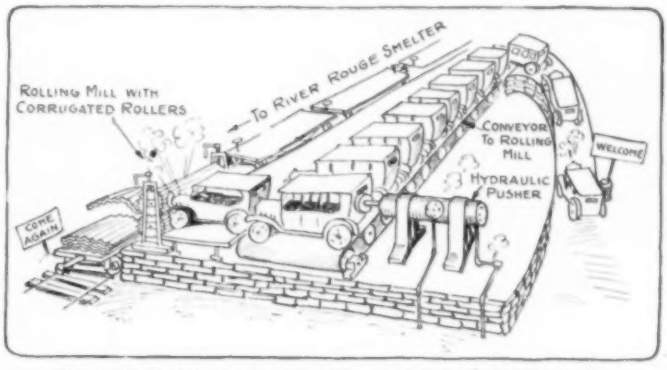
"One thing is certain and that is that none of the present vintage of chariots will be in existence to meet a similar fate 2000 years from now. Most of them find their way back into the open hearth, the cupola and the crucible within 6 or 7 years after the first down payment is made on them.

"The junk yards of the country are overflowing with the melancholy remains of carcasses, gutted and stripped. Every ravine, every city dump and every second backyard con-

tains specimens of cars that rolled proudly off the assembly lines a few short years ago. The remains under the influence of wind and weather rapidly are disintegrating. If a chemist were to analyze a diamond drill core taken from one of these deposits 100 years hence he probably would report traces of iron. Simply that and nothing more.

"I had a letter from my old pal George Pickop recently detailing a clever plan which he proposes to submit to Henry Ford for disposing of all the old model *T* cars, while they are still, as you might say, on the hoof. He also sent me the accompanying drawing which practically is self explanatory.

"The old cars under their own power run up along the ramp to the right. They are assembled in a long line on the platform in the center. This moving platform places them one at a time in front of a hydraulic ram which pushes them into a set of rolls. From the rolls they fall in neat sheets into waiting cars which convey them to the smelter. From the smelter (not shown) they emerge as pig iron and once more pass through all the intermediary steps and eventually emerge once more in a second incarnation. According to the ingenious Mr. Pickop, the method and process present, include and possess many important and advantageous features. For example he points to the collection of empty flasks and other containers with which nearly every old car is infested or afflicted. Under the old dispensation these receptacles were subjected to the combined sniff and eye test and then thrown away in disgust. In the proposed method the flasks go through the rolls with the body, hoofs, hair and hide and supply the necessary fluxing material when the sheets go through the smelter.



THEY ARE HERE TODAY AND ARE GONE TOMORROW

"Talking about smelters and fluxes and one thing and another reminds me that I had a letter recently from a lad who is practically alone in a little jobbing foundry in Australia. He wrote that he was employed at a job with which he was not familiar, making castings for scales in which steel bars are used something after the manner employed in manufacturing bed steads. He would appreciate information on the following points: 1—How to make the iron molds, the approximate analysis of the iron and how to use and care for the molds. 2—How the molds are assembled, set up and poured. 3—How are the metal insets cleaned and coated. 4—Is there any published literature on the subject of rigging and production of weigh bridge and scale parts of cast iron and brass.

"Taking the last question first, I wrote him that the only published reference to cast iron work in connection with bedsteads, so far as I knew, appeared in THE FOUNDRY many years ago and his chance of locating one of the old copies was exceedingly slim. However, the work is comparatively simple and may be described briefly as follows: A number of standard fixtures are erected at the points where the cast iron parts appear on the frame. In some instances a large surface plate is used for the same purpose. Drag halves of the various molds required are located at the proper points and the rods or bars are placed in position. The upper halves of the molds then are clamped in place and the molds are poured one after another with a small ladle. On long running jobs the drag halves of the molds are anchored permanently either on the upright standards or on the plate. Hinged clamps facilitate the assembling and dissembling of the molds. In some instances the molds are hinged and in others the parts are provided with suitable guides, either pin and sockets, or male and female joints. This feature is determined somewhat by the shape and size of the mold.

"The molds are made from a good grade of soft iron, something that will stand a maximum amount of expansion and contraction. On account of the comparatively small bulk of the castings to be made, the service required of the molds is not severe. If made of fairly heavy section they resist distortion and will last for a long period. Suggested analysis for a typical mold 6 x 10 inches, 2 inches thick would be: Silicon 2.30 per cent, sulphur 0.07 per cent, phosphorus, 0.50 per cent, manganese 0.70 per cent.

"Usual care of course must be observed to see that the molds are perfectly dry and free of rust before any metal is poured into them. Naturally this precaution only applies to the first heat of the day. The heat of each succeeding cast keeps the mold in good working condition. Usually the face is swabbed lightly with oil or grease before the mold is assembled in place. The burning oil deposits a carbon film on the mold face.

"Many methods are available for cleaning the inserts. The proper method to adopt will depend on local conditions, including the volume of material to be handled. If an absolutely tight joint is desired it may be necessary to first pickle the rods and then coat them with tin. In other instances a dip in the pickle vat will clean them sufficiently provided they are dried thoroughly before they are placed in the mold. As a precautionary measure the part exposed to the metal may be covered with oil, tar, grease, red lead, pitch, chalk or silicate of sodium, commonly known as water glass. The coating prevents the formation of a thin film of oxide or rust and also prevents the condensation of moisture on the bare metal.

"Where only a comparatively small number of parts are involved and where only a small part of the rod or bar is to be exposed to the molten metal, that particular part may be cleaned on the emery stone and the cleaned surface afterward coated to protect it from moisture as explained previously.

Where a sandblast installation is available, a special device frequently is developed and attached for the purpose of cleaning large quantities of small parts."

Will Meet in Pittsburgh

Dr. T. D. Yensen, engineer in charge of the magnetic section, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., will address the convention of the American Electrochemical society which will be held in Pittsburgh, Sept. 19 to 21 inclusive. Dr. Yensen will explain the building of electrical machinery in the future. He has made extremely pure iron for that purpose which analyzes almost 100 per cent pure. That iron has electromagnetic properties that are superior to the iron now used in electrical machinery.

American Foundry Equipment Co., Mishawaka, Ind., is building an addition to its plant.

Producing Steel Castings in the Modern Foundry

Part VIII

By Charles W. Veach

IN PREPARING ladles to hold a heat of steel, the manner of setting the nozzle, and particularly the depth of the basin around the nozzle, is of prime importance. The author has seen three consecutive heats lost, or partly lost, because the basin was too deep. The faulty design allowed the pool of metal surrounding the stopper head to chill while the crane moved the ladle from the furnace pit to the line of molds. The third heat refused to run when the stopper finally was lifted from its seat in the nozzle. An investigation was started to locate the trouble. Two other ladles were found prepared in which the basin around the nozzle was about 12 inches across, and about 2½ inches deep. This was corrected by cutting down the clay bottom so that it pitched from all points to the nozzle. No trouble has been encountered since that change was made.

Nozzle Must Be Flawless

A nozzle costs but a few cents, yet the sucessful teeming of a heat depends on the quality of the nozzle brick and the way it is set in the ladle. Inspection of the brick before they are placed in storage should be thorough as a flaw in the nozzle may cause a large loss. When nozzles are taken out to be used, they again should be inspected carefully by some person who is competent to judge their fitness. That inspection should reveal any flaw. If the nozzle passes the inspector, it then should be tested to see that the bell is true to permit the stopper head to seat perfectly. A comon defect found in nozzles is an untrue bell. To avoid loss by scrapping those nozzles, a method of grinding the surface to obtain a seat for the stopper has been perfected. A recent investigation has shown that refractory brick having a disturbed, exposed surface, loses much of its refractoriness. For that reason, the author is not in favor of disturbing the bonded surface of the material.

If more than one nozzle in a thousand causes loss while pouring, the fault can be traced either to careless inspection, or to faulty workmanship when the nozzle is placed in the ladle. The best fire clay will withstand more than the average temperature of metal made in an open-hearth furnace and, if the nozzle cracks, it is a case of faulty manufacture.

Assembles Stoppers

SUCCESSFUL pouring of steel castings depends upon the quality of the materials used in the assembly of the stoppers. Another item upon which profit and loss often depends is the perfection of the nozzle. Inspection of sleeves and nozzles, assembly of stoppers and preheating of ladles are discussed in this, the eighth of a series of articles on the production of steel castings in the modern foundry.

However, the manufacturer cannot be charged with all ladle trouble. If a heat is tapped at a temperature of 2950 degrees Fahr. and the nozzle is at 70 degrees Fahr., difference in temperature is too great and almost anything may happen to the nozzle or the stopper. It is inconvenient but safe and economical to preheat the ladle before tapping a heat into it. While the degree of preheat may vary in different shops, each ladle should be brought to a definite heat as standard practice within any one plant. The melter then will know about how much heat will be lost by the steel in bringing the temperature of the ladle lining to that of the metal.

Only a small amount of heat is radiated through the walls of the ladle. By taking metal temperatures at the time of tapping and after only a few molds have been poured, the amount of heat absorbed by the ladle lining may be established. It will be found that the ladle will absorb enough heat from the metal to reduce the temperature of the steel about 100 degrees Fahr. even when the ladle has been preheated thoroughly. Amount of heat thus absorbed depends on the extent to which the ladle has been preheated. When ladles are preheated properly, contact between the hot metal and the ladle lining when the heat is tapped causes a minimum of action. This prolongs the life of the lining and is a desirable condition from a standpoint of metal quality.

Gives Ladle Practice

Setting the nozzle in place and ramming the material around it is an important part of the work of preparing ladles to receive the molten steel. That phase of the work is subject to neglect which may interfere with smooth pouring and also may be the cause of loss of metal. Therefore, it requires untiring watchfulness by the pit foreman or the head ladleman. All nozzle brick are not of the same dimensions but, for the steel foundry, two sizes should be sufficient. The smaller is required to take care of heats up to 20 tons from small open-hearth units, electric units and small converters. Foundries tapping larger heats require larger nozzles.

It is not necessary to increase the diameter of the orifice through which the metal flows in proportion to the increased size of the heat. This will be governed by the nature of the product and the speed of pouring. Speed of pouring depends on the size of the gate and on the thickness and height of the sections most difficult to run.

Dimensions of a nozzle for a 30 ton heat are about as follows: Height overall, 6¾ inches; diameter, 6¼ inches; bell, 1¼ inches deep by 5 inches in diameter at the top side; orifice, 1½ inches in diameter; part extending through the nozzle plate,

length, 1¾ inches, diameter, 3⅝ inches.

The distance from where the nozzle rests on the plate to the bottom of the bell is 3⅞ inches. The thickness of the nozzle wall on any side of the orifice is 2¼ inches. These dimensions show the actual wearing surfaces. It is obvious that undue cutting away of the material by the flowing metal rapidly weakens the nozzle. Brick which show any sign of weakness or irregularity in grain structure of the clay should not be used.

Perfection Is Required

The nozzle plate is attached to the bottom shell of the ladle. The hole through which the nozzle extends as well as the section of the plate on which it seats are machined so as to fit snugly. The height of the nozzle should be such that its top comes flush, or a little above the brick lining in the bottom of the ladle. If the nozzle is too short, the bottom lining must be made thin or the basin around the nozzle will be too deep. If it is too long, the bottom will be unnecessarily deep, and will use valuable space which is required for metal. Contour of the bottom of all ladles should be alike after the nozzles are set and the bottom material rammed in place and smoothed over.

An assembled stopper consists of the rod, stopper-head, special sleeve, regular sleeves, washers and nuts. One end of the rod is threaded for about 15 to 20 inches. That permits a washer and nut to be drawn down against the sleeve brick to hold them in place. The threads also fit the nuts that are used to hold the gooseneck in place. The stopper-head end is bored out to admit the stopper pin, and is slotted to admit a key which also passes through the stopper pin to hold it in place.

Stopper heads generally are made of graphite. A few users advocate stoppers made of clay and graphite mixed. They are fastened snugly but not too tightly to the end of the stopper rod by the stopper pin. The head of the pin is countersunk in the graphite head. When the assembly is complete, about the last task is to fill the countersunk hole with ground graphite to protect the pin from the excessive heat. A sleeve, shaped on the one end to telescope the stopper head, next is fitted on the stopper rod. The part of the head that the sleeve enters then is coated with plastic, finely ground graphite. That makes a joint sufficiently close to preclude the molten steel from coming in contact with the steel rod and pin.

The regular sleeves are placed on the stopper rod after the special sleeve is attached to the head. Approximately 10 regular sleeves are required for a stopper to be used on a 30-ton heat. The ends of the sleeves are coated with fireclay mixed to the consistency of mortar before they are placed together. When the last sleeve brick is in place, a washer is slipped on the rod and the assembly is tightened with a nut.

Is Important Work

Assembling the stoppers is important work. A stopper-head failure is serious and may cause a large loss of metal. A faulty joint between two of the sleeve brick may cause considerable loss. Some steel foundries give each stopper a coating of slurry. This is a mixture of fireclay, graphite, and sometimes sea coal, tempered to a stiff paste and smeared on by hand. Little trouble is encountered from excessive wear of the sleeve brick, or faulty joints when that practice is followed.

Stoppers should be asembled far in advance of the time that they will be used. Nothing is gained by making them up ahead of schedule unless they are placed in a heated atmosphere so that all moisture will be driven off. Several steel foundries have specially constructed furnaces for drying stoppers. Some heat the head of the stopper almost to a red heat just before using it. This practice tends to minimize trouble from broken stopper heads. The brick are not subjected to so great a difference in temperature when the metal strikes the ladle as they are when the stopper is not heated.

Favors Change

Standard dimensions of sleeve tile are approximately as follows: Length, 9½ inches; diameter, 5¼ inches; orifice, 2¼ inches; wall of the tile, 1½ inches. As the stopper rod is but 1¾ inches in diameter, it would seem that 2 inches would be big enough to admit the rod. This would give ¼-inch extra material for wear besides having the tile fit the rod more snugly. However, the matter of having sleeve tile, which is a standard product, changed is not for any one user to undertake alone, but requires concerted action by a large number. The author believes that it would be advantageous to have the sleeve tile made just large enough to slip on the stopper rod. He does not recommend any reduction in the diameter of the tile. If the orifice is to be made smaller, the wall of the tile should be made correspondingly thicker.

Shows Effect of Alloy Additions

IMPROVEMENT of cast iron by addition of various alloying elements is attracting considerable attention the world over. Recently Arthur B. Everest, London, spoke at a meeting of the London section of the Institute of British Foundrymen on the subject of alloy cast iron, and presented some results obtained from his past five years work in developing alloy cast irons. Mr. Everest's conclusions follow:

A preliminary consideration of the suitability of an alloy element, which clearly must take account of cost, alloying properties, and so on, limits to a marked extent the number of elements which appear to justify further investigation. The next factor to consider is, undoubtedly, the influence of the given element on the relative stability of the combined and graphitic carbons in the casting, so that the desired general condition of the iron may be obtained. Next having adjusted the composition of the iron so as to produce the desired general condition, one must study the influence of the alloy element on the specific properties of the individual constituents of the structure of the iron, so that the additions may be made judiciously with a view to obtaining the best all-round results.

Experiments with aluminum in cast iron, which at first sight appears a promising alloy addition, gave disappointing results owing to the difficulty of oxidation of the aluminum in the iron. Consequently, this line has not been followed up extensively.

Experiments with nickel and with nickel-chromium have given definitely promising results, and a general improvement in the properties of cast iron has been demonstrated by the judicious use of these elements, and these may be summed up conveniently by a diagram. The accompanying figure gives the hardness values of a group of cast irons resulting from the

use of alloy elements and control of composition. In this diagram, one division to the right of point *A* corresponds to the addition of 1 per cent of the element indicated, and one division to the left marks a corresponding reduction in composition.

The irons shown have compositions as nearly as possible similar except for the changes indicated, the hardness values are the means obtained on the 1-inch and ½-inch steps of step castings. The composition of the base iron shown at point *A* is as follows:

Element	Per Cent
T.C.	3.1
C.C.	0.67
Si	2.0
Mn	0.85
S	0.10
P	0.17

Given a base iron of this type, nickel may be added to it direct, with a certain improvement in hardness as shown in the illustration. This is often accompanied by an improvement in strength and other properties, but to obtain the maximum benefit of the alloy addition further control of the composition usually is desirable. To obtain the best results in the alloy iron two courses are open to us. The first as shown by the points *C* and *D* involves initially a reduction in the silicon content of the iron to counterbalance the graphitizing effect of the nickel. In this case a marked all-round improvement of the iron generally is obtained. However, if this silicon control is not a practical proposition, then, as indicated by points *E* and *F*, this same result may be obtained by the initial addition of chromium to harden up the iron, this being subsequently rendered machinable by the addition of nickel.

Alloy cast irons, in virtue of their improved properties, are finding extensive application in the engineering world for such castings as cylinders and cylinder liners for automobile engines, compressors, diesel engines and pumps, and for pressure castings

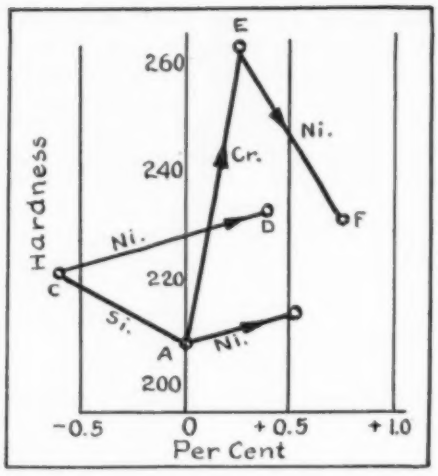
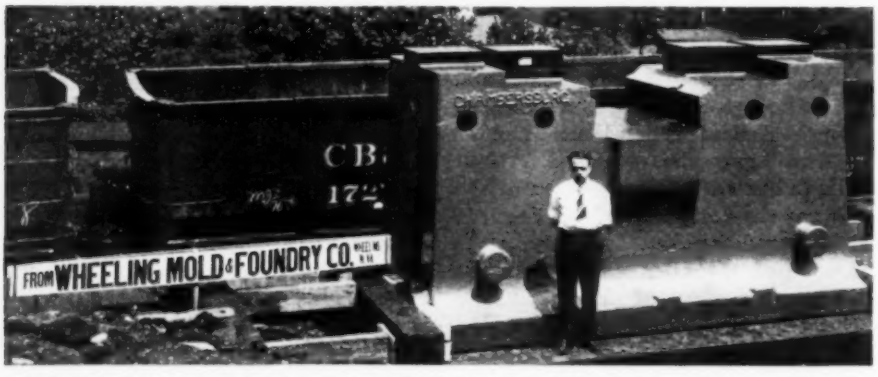


DIAGRAM GIVES HARDNESS OF CAST IRON WITH AND WITHOUT ALLOY ADDITIONS

generally, for pistons, and for heat-resisting castings, molds, etc.

It has been demonstrated that the marked improvement in properties, to which extensive reference has been made, can be obtained at an economic cost; and it is felt definitely that in the development of this class of material, industry has a tool which definitely will help it to regain some of the trade which it has lost in the past few years through the insufficiency of its products. In addition, by increasing its reputation for quality production, the application of its castings may be extended, and this at a price compatible with the improved properties and service rendered.

In the future the foundryman may look forward to a time when cast iron will be restored to its own as eminently the most suitable material for many cast structures, and coupled with the restoration of this material to favor in the eyes of the engineer, he must associate reliability, with which control of composition is synonymous; and, moreover, in the specifications of composition it is to be expected that in the future alloy elements will find a prominent place for all the high-class castings made.



TWENTY TONS OF METAL WERE REQUIRED TO FEED THE CASTING SEVERAL HOURS AFTER IT WAS POURED

Foundry Company Is Organized

The Janesville Foundry & Machine Co., Janesville, Wis., has been organized by A. W. Schlueter, owner of the Schlueter Boiler Works, and Walter Reynolds, of Beloit, Wis. The company has taken over the foundry of the New Doty Mfg Co. at 301-321 North Main street, Janesville, which has been idle for some time. The concern will specialize in gray iron castings for local and nearby industries, including the Northern Conveyor & Mfg. Co., Rock River Engineering Co. and others. Mr. Schlueter will continue to operate his boiler works, Mr. Reynolds being actively in charge of the foundry business.

Makes Large Casting

For the past two years the Wheeling Mold & Foundry Co., Wheeling, W. Va., has been active in the production of large steam-hammer castings. A recent product of the company was an anvil-block casting for a 25,000-pound steam hammer being manufactured by the Chambersburg Engineering Co., Chambersburg, Pa. The finished unit will weigh 240,000 pounds and when it is completed will be shipped to Italy.

The casting is of mild steel of the following analysis:

Element	Per cent
Carbon	0.23
Silicon	0.30
Sulphur	0.029
Phosphorus	0.034
Manganese	0.90

Three heats were required to pour the casting and a total weight of 160 tons was cast. Several hours after pouring a heat of 20 tons was used for feeding.

All known precautions were taken in the molding and pouring as the loss of a casting of such magnitude would mean a tremendous expense. The block was cast with the working face down in a dry sand mold set in the floor, the bottom of the block being level with the floor. Small cores were not considered due to the large volume of metal, but two lightening cores were successfully used in each end.

Temporary trunnions were cast on the ends to facilitate handling in addition to the permanent ones on the sides. These end ones were later removed. Inspection showed the block to be perfectly sound in every particular. No shrinkage cavities or cracks of any kind were apparent. The accompanying illustration shows the anvil block an a car and gives some idea of its overall dimensions.

Simplifies Molding

of Iron Plates for Gas and Chemical Tanks

By J. H. Eastham

CAST iron plates for tanks used in gas, chemical and other plants usually are ordered in sufficient quantity to warrant special equipment. Even when the order only covers a number as low as 100, the average general jobbing shop is justified in spending a little money in special flasks. The casting shown in Fig. 1, approximately 4 feet square with a ribbed flange on all four sides and weighing approximately 500 pounds is fairly typical of that class of castings.

Where the foundry is equipped with a jolt rollover molding machine, the job is simplified greatly, but even where one of these labor saving devices is not present, considerable savings may be effected in the following manner.

Make Skeleton Pattern

A skeleton pattern is made with the interior ribs all in place and with the bolt hole core prints fastened on the *outside*. Where the prints are fastened on the inside it is necessary to nail each core in place. The top of the heel print on the outside touches the cope and holds the core without any nail. Also a cleaner draw is assured where the brackets are on one side and the prints on the other side. Particularly on a pattern of this kind where

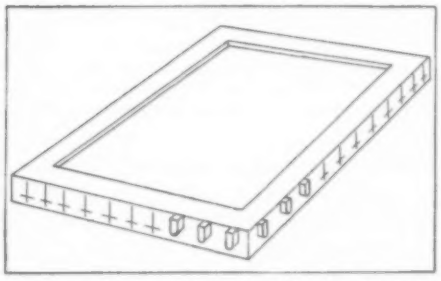


FIG. 2—TANK PLATE SKELETON PATTERN

the brackets and prints are so numerous.

Where plates are ordered in various sizes it is advisable to make a number of light one-piece cast-iron flasks providing approximately 9 inches clearance on each side of the largest pattern. Instead of plates, the drags are provided with flat bars across the bottom. Twice as many drags as copes are required. Which means that while the drag is utilized only once each day, the cope is used twice. The joints of the flasks are machined.

Lay Drags on the Floor

In practice the drags to the required number for the day's operation are laid down on the floor in an approximately level position. The drag is filled with sand and the pattern is bedded into position with the upper surface perfectly flush with the machined joint of the drag. Weak facing is used on the outside and inside and the sand is tucked carefully into the corners of the brackets. The flat surface inside the frame is vented all over and then struck off with a suitable straight edge. Plain sand or a weak facing is used on this part of the mold to prevent a cold shut.

The pattern is swabbed, rapped and drawn out of the sand and then the inner edge of the mold is finished rapidly with the aid of two loose brackets which are moved from space to space. With the majority of sands it is advisable to sink a nail in each sand corner next to the bracket. This prevents the exposed corner from crumbling or moving under the impact of the stream of iron.

Set Bolt Cores

After setting the bolt cores, a row of shallow gates is cut along one side and a light coat of blacking is applied to the mold face in the vicinity. With exceptionally heavy castings a coat of blacking may be required all over the face of the mold.

The cope flask is provided with guide and clamping lugs on both sides, with trunnions for convenience in turning, with the bars chamfered on both edges and extending to within ½-inch of the face represented by the machined joint. This cope 5 inches deep and with 5-inch spaces between the bars will require no gag-

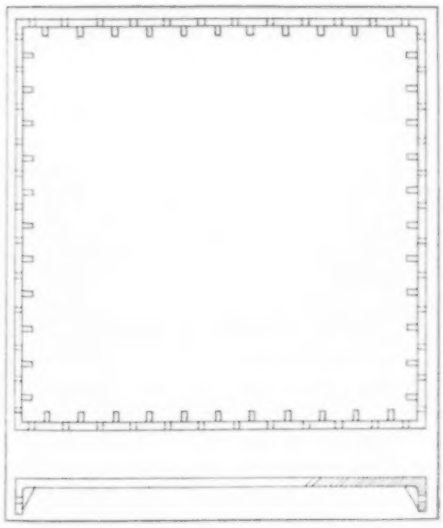


FIG. 1—TANK PLATE CASTING IN PLAN AND SECTION

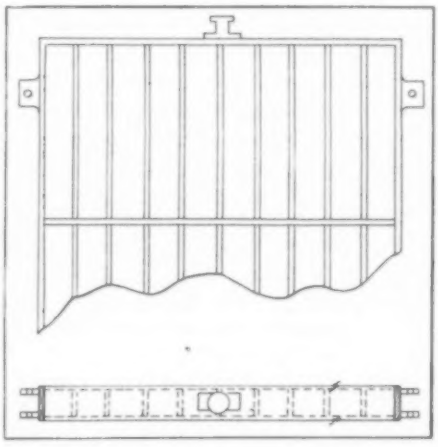


FIG. 3—PLAN AND SECTION OF COPE FLASK

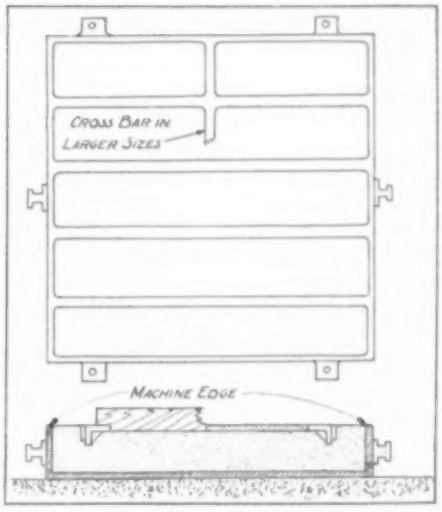


FIG. 4—DRAG FLASK ABOVE AND DRAG MOLD, PATTERN AND STRIKE BELOW

gers to hold the sand. The copes are rammed in succession on a large flat plate or board provided for the purpose. The upper surface is formed with a straightedge. Gate pins are adjusted in place on two opposite sides, one set for the first casting and another set for the second.

Immediately after the metal has set in the first casting the head is removed and the sand is loosed around the sprues. The cope then is lifted, turned over and placed on the second drag, where the head is built up and the mold made ready for the iron. On comparatively small flasks it may be necessary to plug the openings left by the first set of gates, but on the larger flasks this is not necessary. No risers are needed.

Chain Belt Issues New Equipment Catalog

Chain Belt Co., Milwaukee and its subsidiary, the Stearns Conveyor Co. Cleveland, have issued a 815-page catalog. The first few pages of the book are devoted to views of the Chain Belt plant, a discussion of the advantages of mechanical handling, a list of the industries served by the company, notes on ordering and types and applications of chains and conveyors. The next section discusses engineering features and care of conveyors. Various type chains are illustrated and their specifications described. Elevators are described and illustrated with line drawings and halftone reproductions in the next section. Bucket carriers, different type conveyors and water screening machinery also receive considerable attention. The book is well illustrated with reproduction of photographs of typical installations and drawings showing general assembly features.

Four Companies Merge

Negotiations were completed August 31 by the Stacey Engineering Co., Columbus, O., for the acquisition of the Stacey Bros. Gas Construction Co., Cincinnati, the Connersville Blower Co., Connersville, Ind., and the Wilbraham-Green Blower Co., Pottstown, Pa. The Stacey Engineering Co., a new Ohio corporation, will operate as a holding company. The merging companies have been engaged for a long period in the manufacture of gas holders, gas exhausters, blowers, pumps and other apparatus used by oil and gas companies.

The new holding corporation is headed by Bemon G. Dawes, chairman of the board of the Pure Oil Co. With him are associated Carmi A. Thompson of Cleveland, F. S. Heath of Columbus and others, as well as a number of the operating heads of the companies named. Directors and officers of the company are as follows: B. G. Dawes, chairman of the board; Carmi A. Thompson, president; F. S. Heath, Wayne Stacey and John T. Wilkin, vice presidents; D. H. Mulloney, secretary, and C. A. Ward, treasurer. The home offices of the Stacey Engineering Co. will be located at Columbus, O., for the present.

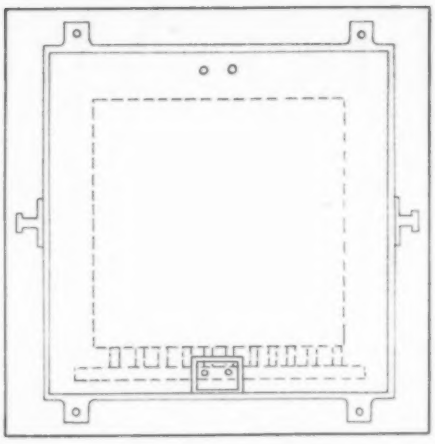


FIG. 5—PLAN VIEW OF FINISHED MOLD

Proposes Revision of Freight Rates

A. E. Later, an examiner of the interstate commerce commission, has prepared a proposed report for the commission in which he found that the rates on rough steel castings from Lima, O., to Gibson, Grasselli, Burnham, Hammond, East Chicago and Calumet, Ind., and Hegewisch and Chicago, Ill., were not unreasonable in the past but they are unreasonable for the future. He proposes that reasonable rates be prescribed for the future. This proposed decision is in the case of the Ohio Steel Foundry Co., Lima, O., against the Baltimore & Ohio railroad.

Paper Mills Use Castings

(*Concluded from Page* 778)

One of these dryer heads 5 feet diameter and weighing about 1500 pounds is shown in Fig. 10. Specifications for the driver head are quite exacting. The slightest draw, segregation or porosity at the neck will cause trouble when the machine is running at high speed. Usually the casting is poured in the position shown, that is with the journal bearing in the core.

Screens of various sizes and meshes are employed in large numbers and continual experimenting is going on in this department. One of these castings is shown to the right in Fig. 1. An ingenious method for making the mold is illustrated in Figs. 6 and 9. Only one vertical line of openings is shown on Fig. 6. The casting carried 24 of these with four openings to a row or a total of 96 openings. The openings were made by cores from the corebox shown in Fig. 2. Two tiers of these cores, one mounted on top of the other, formed the outer wall of the mold. They were assembled around a center core made by ramming sand inside the suitable diameter pulley ring and drawing the ring to the required height. The small segment cores shown at the bottom of Fig. 2 were employed to form the internal flange on the casting. The inner core was blackwashed and skin dried before the slab cores were assembled around it. The entire assembly was surrounded by a flask and heap sand was rammed in the space between the cores and the flask wall to hold the cores firmly in place. This feature is shown in the upper part of Fig. 9. Continual changes and improvements in this type of machinery call for new patterns and new castings.

Fluorspar Output Is Up

The outstanding feature of the fluorspar industry in 1928 was the increase in the rate of duty on fluorspar that contains not more than 93 per cent of calcium fluoride, according to a recent bulletin issued by the department of commerce. This rate increased from $5 to $7.50 a short ton. Domestic shipments were the largest since 1922 and the imports were the smallest since 1923. Mining of that material was resumed in Nevada. In 1928 the shipments of fluorspar from domestic mines aggregated 140,490 short tons, valued at $2,656,554, an increase of 25 per cent in quantity and 31 per cent in value over 1927. That substance is mined chiefly in five states, Illinois, Kentucky, New Mexico, Colorado and Nevada. The foundry industry in 1928 used 3694 short tons of fluorspar or 2.63 per cent of the output. That amount was valued at $66,215 and had an average value of $17.93 per ton.

Installs New Equipment

General Bronze Co., 3212 Smallman street, Pittsburgh, is installing new equipment in its plants. That company has contracted for a centrifugal molding machine for the production of bushings and other castings. The melting capacity is being doubled and the installation is expected to be completed in the near future.

What Others Are Thinking

Abstracts Selected from the World's Foundry Literature

Gives Electric Furnace Data

Report on the Results of the Questionnaire of the Electric Furnace Committee of the Verein Deutscher Giessereifachleute on the Dimensions and Capacities of the Electric Arc Furnaces, Die Giesserei, Dusseldorf, Germany, May 10, 1929.

The electric furnace committee of the Verein Deutscher Giessereifachleute sent a questionnaire to German, Austrian, Hungarian and Czecho-Slovakian electric steel works requesting information on their electric furnaces. Replies were received from 18 plants which employed 1 acid lined and 23 basic lined arc furnaces. Furnaces were divided into seven groups based upon the capacity. The first including those up to 1 ton, and the seventh those having a capacity between 12.8 and 15 tons. Data presented in the form of tables and diagrams contains information on general dimensions of the furnaces; voltage used and kilowatt consumption; efficiency, kilowatt consumption and melting time; duration of refining period; distribution of time of working heat per ton; durability of lining and consumption of refractory materials, etc.

Removes Sulphur

The Elimination of Sulphur from Alloys of Iron, by K. Gierdziejewski, *Foundry Trade Journal*, London, June 20, 1929.

According to the author, sulphur may form several compounds with iron and manganese as follows: Iron sulphide, which has a melting point of 1200 degrees Cent.; manganese sulphide which has a melting point of 1620 degrees Cent.; iron-manganese-sulphide eutectic which has a melting point of 1181 degrees Cent., and iron-iron sulphide eutectic which has a melting point of 980 degrees Cent. Iron sulphide is dissolved easily in molten metal while manganese sulphide with its low specific gravity rises to the surface of the bath and may be removed with the slag. Maximum solution of sulphides in slags is obtained when the slags contain large amounts of the oxides of the elements which in this case are MnO and FeO. Under conditions existent in the cupola it is possible to raise the MnO and FeO contents by increasing the amount of manganese in the charge; introducing into the charge a manganese-rich flux such as manganese ore or manganese-rich slag; and by the use of basic slags. The author has found the increase of manganese content advantageous and recommends that enough manganese be included so that a minimum of 0.7 per cent manganese be obtained in the cast metal. The iron should be run hot enough from the cupola so that it may be allowed to stand for a time to complete the reaction between iron sulphide and manganese. A basic slag containing 35 to 45 per cent total CaO plus FeO desulphurizes well, but is not as fluid as it might be. Fluorspar will assist in fluidizing the slag to a large extent. Sodium carbonate also gives good results if it does not come into contact with slag containing silica.

Classifies Pig Iron

Study of the Classification of Pig Irons. Bulletin de l'Association Technique de Fonderie de Belgique, Brussels, June, 1929.

The article is divided into three sections. The first section gives the scheme of classification of the Association Technique de Fonderie of France. This covers pig iron castings, which include phosphorus pig iron with 1.5 to 2.0 per cent phosphorus, semi-phosphorous with 0.5 to 1.0 per cent phosphorus and hematite with 0.12 per cent phosphorus maximum. European and American malleable pig iron come next, and finally pig iron for steel foundries, which includes hematite for the small converter and for the open-hearth furnace.

The second section reviews the position of the subject in the United States and in Germany. The Germans divide their pig iron into three groups, according to the phosphorus contents. The third section gives the proposals of the committee of the Belgian association. It is found that the permissible variations of the French project, especially as regards silicon contents, are too wide, and the Belgian committee concurs with the American specification. The arcticle ends with a paragraph on the method of control. The committee concurs with German in the method of taking 3, 4 or 5 sample pigs for a charge of 10, 15 or 20 tons and also recommends the analysis of each pig separately.

Uses Rotating Forehearth

The "Giree" Cast Iron, by L. F. Girardet. *Bulletin of the Association Technique de Fonderie*, Paris, May, 1929.

In the bulletin of February, 1928, the author described certain experiments made with the object of obtaining high-duty cast iron. Among other factors it had been found that by using a rotating forehearth, good results were obtained. Thence the name given to this iron, the French word *giratoire*, meaning rotating.

In the present article, after recalling the principles given in the preceding bulletin, the author presents the results obtained from further experiments, on ordinary cast iron and on semisteel. In both cases no appreciable change in chemical composition, after rotation, has been found. In the case of ordinary iron, the shearing strength is increased by rotation by about 40 per cent, and the brinell hardness increases and becomes uniform on various points of the piece, the test piece having been previously polished. In the case of semisteel, the increase in the shearing strength is about 20 per cent greater, and the brinell hardness shows no appreciable variation.

Micrographs shows the modifications brought about by rotation in the structure of the iron. In ordinary cast iron handled by this method the graphite becomes divided into flakes and lamellae throughout the casting. The pearlite also is more homogeneously divided, and the lamellae of cementite are reduced in thickness. Similar results were obtained in the semisteel micros.

A test made to show the effect of corrosion on rotated iron is described in full, the attacking medium being the liquor used in the manufacture of soda by ammonia. It was found, after a two-hour test at a temperature of about 73 degrees Cent., that the loss of weight in the case of the rotated iron was 24.4 per cent less than if not rotated.

Remedies for Defective Castings

Defects in the Manufacture of Cast Iron and Steel Castings, by Berhard Osann, *Die Giesserei*, Dusseldorf, Germany, May 24, 1929.

The author places defective castings in 11 divisions which include porous metal, metal too hard; metal too soft; sluggish metal· piping; segregation; shrinkage; gas holes; scabbing; permanent growth. and inverted chill. Porosity in castings may be corrected by using low-carbon, low-silicon iron with a phosphorus content about 0.4 per cent. The iron must be chosen so that the kish graphite is nil, and the castings do not become too hard. Too hard castings may be remedied by maintaining the proper carbon and silicon content. If only an occasional hard casting is obtained annealing at 800 degrees Cent., cooling to 600 degrees in the furnace and then in air. Such treatment has lowered brinell hardness from 194 to 135. Another heat treatment is to heat the castings at 370 degrees Cent. for seven hours, then decrease the temperature to 360 degrees for 20 hours—cool in air. Sewing machine parts have been annealed by placed in an empty pouring ladle and covering with ashes or charcoal dust. Allowing the castings to remain in the sand also helps. Piping or volume contraction may be remedied by proper placing of risers,, or better by changing the design so as to eliminate sudden changes from heavy to light sections. The author then discusses the subject of segregation, shrinkage, gas holes, etc.

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¶ In One Year's Time

JUST a little over a year ago, the Gray Iron institute started to work on its program of aggressive principles announced earlier in the year at its organization meeting. In August, 1928 the board of directors of the institute appointed Arthur J. Tuscany manager. At that time the organization numbered only forty to fifty foundry company members. Today, this membership has been increased to more than two hundred. Starting with no financial backing, the institute has been operated and expanded to a working basis entirely upon its income from members dues. It is solvent and self-sustaining, active and aggressive at one year after its work was launched.

A CHANGE in the public appreciation of gray iron castings already is apparent. Gray iron means to the lay mind a material which is dependable and useful for a wide range of service. The shadow of reproach carried in the term *ordinary cast iron* no longer darkens the path of the gray iron foundryman. Disparagement of all products of gray iron foundries lacks the enthusiasm which carried every slighting reference to *cast iron* into the public print during the past few years. Some, if not all, credit for this change of popular opinion may be assumed by the Gray Iron institute. With the coming year many more accomplishments along the lines of business advancement for the gray iron industry will be furthered by that organization.

¶ Helpful Suggestions

A CERTAIN foundry in Knoxville, Tenn., has placed a suggestion box in the plant where the men may place descriptions of their ideas to improve operating efficiency. This is a good method for obtaining the confidence of the men and has worked to the company's advantage in many large, as well as small industries. It gives the men the feeling that they are not considered machines, but that they are craftsmen and know their work. Of course, the added remuneration that usually accompanies accepted suggestions is a further inducement.

ONE large manufacturer of electrical equipment gives regular monthly rewards for the best suggestions that have been brought to the company's attention during that period by the workmen. That company has profited by its policy and it would be well for foundries to adopt the suggestion box or some similar plan to give the men a chance to aid the firm for which they work. Such plans that give the workmen a feeling of partnership inspire their confidence in their employer.

¶ Why Not Roof With Iron?

PERENNIALLY some foundryman or some one closely associated with the industry puts forward the idea that cast iron will make good roofing material. The suggestion is not new, but when someone actually devises a slab, strip, tile or shingle to serve the roof builder, the way will be clear for an important field for cast iron. Too heavy, says the architect. Concrete slabs weigh from 10 pounds per square foot for the lightest material made with special aggregate to 20 to 25 pounds per square foot for the unit reinforced type. Slate weighs from 8 to 20 pounds and plain tile as much or more for each square foot unit. Cast iron plates, ¼-inch thick will weigh less than 10 pounds a square foot and a section ½-inch thick would weigh under 20 pounds per square foot.

THAT the idea of cast iron roof construction is not new has been shown repeatedly by reference to the dome of the United States capitol building at Washington which was covered with cast iron plates. This job, undertaken in 1856 when the old wood roof, sheathed with copper was removed, was not completed until 1865, when the collosal head of Columbia was set in place to an artillery salute of 35 guns. The dome required 8,909,200 pounds of cast iron, purchased from James Beebe & Co., Baltimore for 7 cents a pound.

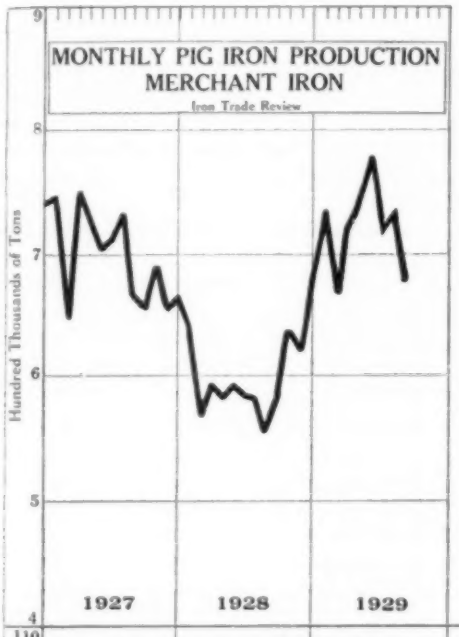
THE inspiration stands. What is good enough for the capitol should be excellent for thousands of industrial and commercial structures. Only the initiative and genius of some inventive soul is needed to open a market for cast iron roofs. Rust resistance, strength to withstand snow and wind load, durability and appearance are qualities to be sought. The challenge is open to gray iron, special alloy cast iron and perhaps also to malleable and cast steel.

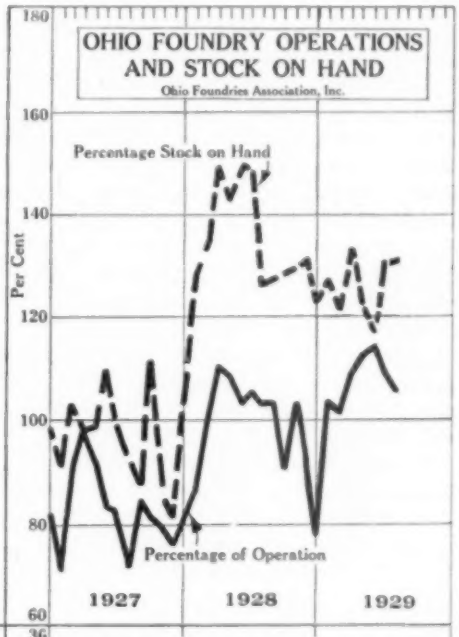
Trade Trends in Tabloid

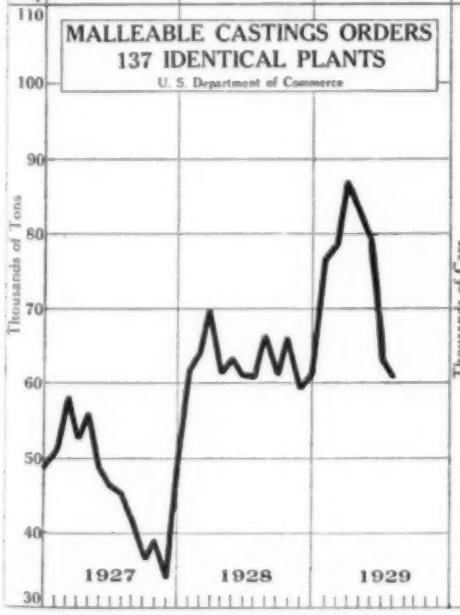
THE business outlook in the foundry industry for early fall is encouraging despite slight recessions in malleable and steel castings orders and a decline in automotive production with its reflex upon the gray iron branch. An up turn is expected in farm implement manufacture and sales, in line with improved crop prices. Power machinery is in greater demand in rural centers than ever before and tractor and truck sales are increasing. The automobile industry has curtailed operations slightly although a pickup was noted in the first weeks of August. Car loadings have mounted to a new peak, the total being in advance of last year and each week of August showing an advance over the corresponding week of 1928. Pig iron production in August showed a slight decline, according to statistics compiled by *Iron Trade Review*. August totaled 3,738,439 tons compared with 3,782,511 tons for July and 3,136,995 tons for August last year. The daily average output this August was 120,594, a drop of 1.16 per cent compared with the preceding month. Merchant iron production was 678,252 tons compared with 741,622 tons for July. Average daily prices for nonferrous metals during August according to New York prices in *Daily Metal Trade* follow: Casting copper, 14.376c; electrolytic copper, 14.750c; Straits tin, 48.038c; lead, 6.248c; antimony, 10.093c; and aluminum, 23.90c.

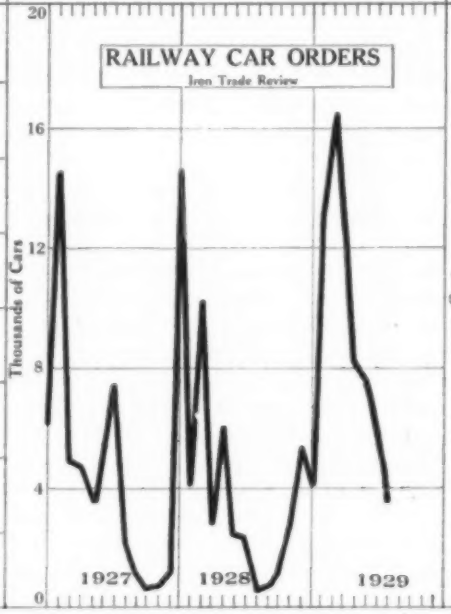
RAW MATERIAL PRICES
Sept. 7, 1929

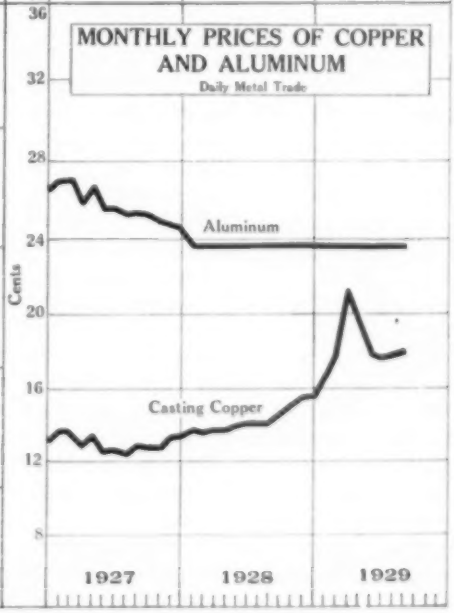
Iron	
No. 2 foundry, Valley	$18.50
No. 2 southern, Birmingham	14.50
No. 2, foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.50
Basic, Buffalo	18.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville beehive coke	$3.75 to 4.85
Wise county beehive coke	4.25 to 4.50
Detroit by-product coke	8.50 to 9.00
Scrap	
Heavy melting steel, Valley	$19.00 to 19.50
Heavy melting steel, Pitts.	18.50 to 19.50
Heavy melting steel, Chicago	15.25 to 15.75
Stove plate, Buffalo	13.00 to 13.50
Stove plate, Chicago	11.50 to 12.00
No. 1 cast, New York	12.50 to 13.00
No. 1 cast, Chicago	15.00 to 15.50
No. 1 cast, Philadelphia	17.00
No. 1 cast, Pittsburgh	15.00 to 16.00
No. 1 cast, Birmingham	13.00 to 14.00
Car wheels, iron, Pittsburgh	16.50 to 17.00
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	17.00 to 17.50
Malleable, Buffalo	18.00 to 18.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	18.00
Electro, copper, producers	17.90 to 18.12½
Straits tin	45.62½
Lead, New York	6.90
Antimony, New York	8.75
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Alumnium, No. 12, remelt	17.00 to 17.50
Zinc, East St. Louis, Ill.	6.80











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

ERNEST LANCASHIRE has resigned as a member of the faculty of the University of Illinois to become connected with the American Steel Foundries at the Granite City, Ill., plant. Mr. Lancashire received his metallurgical training at Sheffield university, Sheffield, Eng. He served as assistant in the Brown-Firth Research Laboratories, Sheffield, for four years and also worked as shift chemist for the Newcastle Alloy Co., Newcastle-on-Tyne, Eng., manufacturers of both acid and basic electric steel. Mr. Lancashire left England and came to the United States in August, 1923, and entered the employ of the American Steel Foundries as metallurgical and research chemist at the Granite City, Ill., plant. Later he resigned to become metallurgist for the Standard Brake Shoe & Foundry Co., Pine Bluff, Ark. He served with that company for two years when he resigned to become instructor at the University of Illinois, Urbana, Ill., where he taught heat treatment of metals and the microscopic analysis of iron and steel. Mr. Lancashire is a member of the American Foundrymen's association and of the American Society for Steel Treating.

William Roman, formerly coreroom foreman for the Waukegan Foundry Co., Waukegan, Ill., has been promoted to foundry superintendent.

C. H. Lage has become associated with the Caterpillar Tractor Co., Peoria, Ill. He formerly was connected with the International Harvester Co.

Fred Foote, formerly superintendent of the Milwaukee Gray Iron Foundry Co., Milwaukee, now is associated with the Prime Mfg. Co., Milwaukee, as foundry superintendent.

F. B. Lohnes, formerly connected with the General Electric Co., at the Lynn, Mass., plant, now is associated with the Old Colony Foundry Co., East Bridgewater, Mass.

Ernst Heyde, formerly foundry superintendent for Scalla & Co., Buenos Aires, Argentina, S. A., has returned to the United States. He formerly was connected with the Wolff Mfg. Co., Chicago, and the Standard Sanitary Co., Richmond, Calif.

Dr. Richard Moldenke addressed the St. Louis District Foundrymen's club at its monthly meeting at St. Louis, Sept. 13. In addition to the invitations issued to the regular members of the club, invitations were sent to foundrymen in neighboring cities.

Charles Piez, recently nominated for president of the American Society for Mechanical Engineers, was born in Germany in 1866 of naturalized American parents. He received his technical training at the school of mines, Columbia university. He was graduated in 1889 and entered the employ of the Link-Belt Engineering Co., Philadelphia. In 1906, he had become chief engineer and general manager of that company. In that year the Link-Belt Co., Chicago; Link-Belt Engineering Co., Philadelphia, and the Ewart Mfg. Co., Indianapolis, were consolidated to form the Link-Belt Co., and Mr. Piez was elected president. In 1917, he was selected to be vice president and general manager of the United States Shipping Board Emergency Fleet Corp. On May 1, 1919, he resigned as director general of the shipping board and returned to his private business as president of the Link-Belt Co. Mr. Piez was elected chairman of the board of directors of the Link-Belt Co. in 1924. He is a member of several Chicago clubs and a director of banking institutions. He is a member of the executive committee of the Museum of Science and Industry, founded by Julius Rosenwald, Chicago, and is a member of the American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, Society of Naval Architects and Marine Engineers, and the Western Society of Engineers. Other men nominated as officers of the society include: Vice presidents, Paul Doty, St. Paul; Ralph E. Flanders, Springfield, Vt.; Ernest L. Jahncke, Washington; Conrad N. Lauer, Phiadelphia. Those nominated as managers are: Harold V. Coes, New York; James D. Cunningham, Chicago; Clarence F. Hirshfield, Detroit.

CHARLES PIEZ

M. E. Finck has been elected secretary of the Murray Iron Works Co., Burlington, Iowa, engineer, founder and boiler maker. He succeeds the late C. H. Schroder. Miss M. R. Nairn has been elected assistant secretary and treasurer to succeed Mr. Finck.

Frank Hudson, formerly chief chemist and metallurgist at Glenfield & Kennedy, Kilmarnock, Scotland, resigned that position and has become chemist and technical advisor to Fordath Engineering Co., Ltd., West Bromwich, England. Mr. Hudson entered upon his new duties Aug. 1.

O. M. Carry is president of the new Michiana Products Corp., Michigan City, Ind., organized to take over the properties of the Chrobaltic Tool Co., manufacturer of heat and acid resisting alloy castings, and the Sheet Steel Products Co., manufacturer of agricultural implements, etc. W. B. Sullivan is first vice president and general manager, located at Michigan City.

John C. Alberts, from 1916 to the present eastern representative of the machinery division, Osborn Mfg. Co., Cleveland, has resigned to accept a position as production manager of the Plainville Casting Co., Plainville, Conn. Prior to his connection with the Osborn company, Mr. Alberts was production clerk of the foundry division of the Union Switch & Signal Co., Swissville, Pa., and from 1914 to 1916 was instructor in the foundry division of the school of applied industries, Carnegie Institute of Technology, Pittsburgh.

Joseph Gaffney has been appointed assistant to P. C. DeBruyne, superintendent of the Moline Malleable Iron

Co., St. Charles, Ill., a newly created office. Mr. Gaffney has had charge of the shipping department for three months. Frank Tuytschavers, until recently assistant foreman of the annealing department under Mr. Gaffney, now is foreman of that department. Albert Regelbrugge,. formerly assistant foreman of the shipping department, has been promoted to be foreman, succeeding Louis Andrews, who has been transferred to the general office.

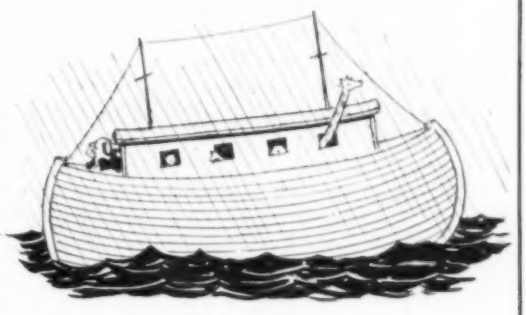
J. H. Anderson, formerly connected with the Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill., has been appointed foundry superintendent of the Litchfield Mfg. Co., Waterloo, Iowa. That company is reopening its foundry which has been idle for the past six years. Mr. Anderson prior to his association with the Mt. Vernon Car Mfg. Co., was foundry superintendent for the C. S. Bell Co., Hillsboro, O., which position he resigned to become general superintendent for the Root-Heath Mfg. Co., Plymouth, O. He also was connected with Sweet & Doyle, Green Island, N. Y., with Stover Mfg. & Engine Co., Freeport, Ill., as foundry superintendent and with the Traction Foundry & Machine Co., La Porte, Ind., as general manager. Mr. Anderson has been a contributor to the technical press.

Safety Council To Meet

The eighteenth annual safety congress, which will be held in Chicago from Sept. 30 to Oct. 4, is expected to be a banner occasion. At least 7000 persons are expected to attend the sessions of the council. There will be 354 speakers for the 41 separate program divisions and 125 sessions. The speakers will represent every state in the United States and a number of foreign countries. The headquarters for the congress will be the Stevens hotel. However, since extensive activities are being planned the Congress hotel and the Eighth Street theater also will be used as convention centers.

The metals section of the society will hold its meetings on the third floor of the Stevens hotel in the north ballroom. Meetings of that section will be held each morning during the convention. The first meeting will be held on Sept. 30, and will be a luncheon at which reports of the various committee chairmen will be heard. The luncheon then will be addressed by Dr. Harry Myers, superintendent of personnel, Frigidaire Corp., Dayton, O. The Tuesday meeting will consist of an address by George Seyler, works manager, Lukenheimer Co., Cincinnati, and papers by J. E. Culliney, safety engineer, Bethlehem Steel Corp., Bethlehem, Pa., and F. G. Bennett, safety director, Buckeye Steel Castings Co., Columbus, O. Discussion will follow each of the papers and the one by Mr. Bennett should be of particular interest to foundrymen. New officers for the metals section will be elected at that meeting. Wednesday session will include papers by P. J. Stremmel, general superintendent, Granite City Steel Co., Granite City, Ill.; J. M. Woltz, safety director, Youngstown Sheet & Tube Co., Youngstown, O., and H. S. Smith, consulting engineer, Union Carbide Co., New York. The final session will include a dialogue, a paper by John A. Oartel, chief of safety bureau, Carnegie Steel Co., Pittsburgh.

Faked Foundry Facts



Continuous Pouring

Toledo Will Greet Ohio Foundry Gathering

Oct. 10 has been designated as the date of the first of four sectional meetings of the Ohio Foundries Association Inc. This meeting, which will be held in Toledo, will include a program planned to interest and instruct foundrymen and also will be the occasion for the annual election when five new members of the board of directors will be chosen. Elmer F. Scott, Penton building, Cleveland, secretary-manager, has extended an invitation to all foundrymen of Ohio, whether or not they are members of the association to attend this gathering.

General Refractories Co. has established its Cleveland office at 1126 Leader building.

Hold Heating Exposition

The first International Heating and Ventilating Exposition will be held at the commercial Museum, Philadelphia, in connection with the thirty-sixth annual meeting of the American Society of Heating and Ventilating Engineers, Jan. 27 to 31. Heating and ventilating plants of various types and accessories will be shown. Thornton Lewis, president of the society, has appointed the following exposition committees: Advisory committee, H. P. Gant, York Heating & Ventilating Corp., York, Pa.; A. S. Armagnac, *Heating and Ventilating Magazine;* D. S. Boyden, Edison Electric Illuminating Co., Boston; W. H. Carrier, Carrier Engineering Corp., New York; A. C. Edgar, Certified Heating Association Inc.; Roswell Farnham, Buffalo Forge Co., Buffalo, N. Y.; C. V. Hayes, Hoffman Specialty Co., Chicago; E. B. Langenberg, Langenberg Mfg. Co.; J. I. Lyle, Carrier Engineering Corp., New York; F. J. McIntire, United States Radiator Corp., New York; H. C. Murphy, Reed Air Filter Co.; F. R. Still, American Blower Co., Detroit; E. K. Webster, Warren Webster Co., Camden, N. J., and H. L. Whitelaw, American Gas Products Co. The co-operating committee consists of O. H. Fogg, president, American Gas association; C. H. Hammond, president of the American Institute of Architects; E. M. Fleichman, president, American Oil Burner association; A. J. Wood, president, American Society of Refrigeration Engineers; Walter Klie, president, Heating and Piping Contractors National association; H. T. Richardson, president, National Boiler and Radiator Mfg. association; John W. Meyer, president, National District Heating association; W. C. Hanson, president, National Pipe and Supplies association; C. E. Hall, director, National Warm Air Heating association, and R. T. Creviston, manager, Plumbing and Heating Industries bureau. Charles F. Roth, Grand Central Palace, New York, is manager of the exhibition.

Polytechnic Institute of Brooklyn, 99 Livingston street, Brooklyn, N. Y., has issued a bulletin on its graduate courses in engineering, chemistry, physics and mathematics. The bulletin outlines the requirements and fees, gives a list of the faculty of the institution and the schedules of the graduate courses in the various subjects offered for the next term.

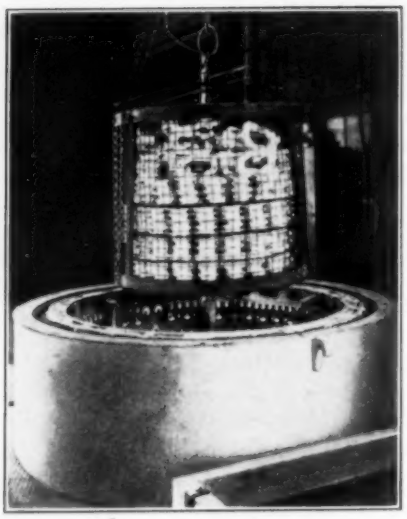


FIG. 1—CASTINGS ARE CHARGED IN A SPECIAL BASKET

Heat Treats Aluminum

General Electric Co., Schenectady, N. Y., recently introduced a new furnace designed especially for the heat treatment of aluminum alloys. The new furnace is a pit-type, cylindrical unit having two circuits. One circuit, rated at 220 volts, 3 phase with a Y-series connection, is located at the top while the second circuit, rated at 220 volts, 3 phase with a Y-delta connection, is located in the lower side well and the bottom. At high heat the power consumption is 84 kilowatts and at low heat 28 kilowatts.

In a typical application of this furnace, a run of castings weighing approximately 500 pounds plus a basket weight of 700 pounds, both at room temperature, was placed in the furnace at a temperature of 960 degree Fahr. In 1½ hours the center of the charge was at the heat treating temperature, although for a third of that time the furnace was operating on low heat. A check showed that the outside of the charge next to the heating units was no higher than 960 degree Fahr.

In that furnace the diameter was 4 feet and the depth 6 feet. It was designed to heat a charge weighing 1500 pounds plus a basket weight of 500 pounds from 600 to 950 degree Fahr. in one hour, and the hold the charge at the latter temperature for 12 hours. The estimated radiation at the holding temperature is 17 milliwatt-hours per hour.

Union Chain & Mfg. Co., Sandusky, O., has opened two new sales offices one in St. Louis and the other in Indianapolis. Hugh Scott, is in charge of the St. Louis office located at Third and Plum streets, while A. R. Young is in charge of the Indianapolis office.

Designs New Type Truck

Oxweld Acetylene Co., 30 East Forty-second street, New York, recently has introduced two new type trucks for low-pressure acetylene generators and oxygen cylinders. Two wheels carry the back part of the truck and a third wheel of the castor type allows the truck to be turned in a radius about equal to its length. Generators are secured to the truck by angle iron braces and bolts that are tightened by turnbuckles. Two oxygen cylinders may be mounted on the larger truck and the smaller unit accommodates one cylinder. The tanks are held on the carriers by a chain which is fastened to the truck deck beside the generator. A crane is provided for charging and emptying the generator on the larger truck. The crane jib is made in three sections which can be telescoped when not in use to decrease the height. The larger truck is equipped with two 24-inch,

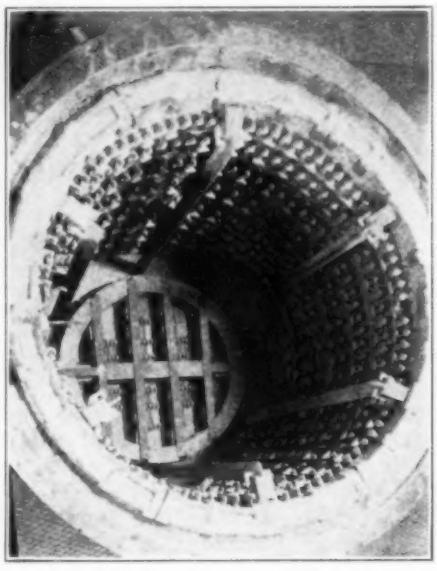


FIG. 2—INTERIOR VIEW OF THE PIT TYPE FURNACE

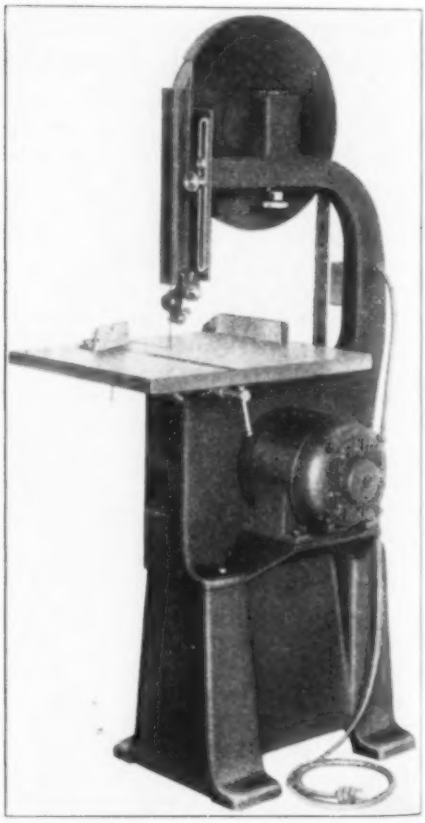
steel wheels with 3-inch tires and a castor wheel 12 inches in diameter with a 2-inch tire. The smaller truck has two large wheels of the same dimensions as the larger truck but the castor wheel is 5 inches in diameter operating on a roller bearing. All wheels of both types are equipped with grease cups for lubrication.

Institute Expands

The Gray Iron institute, Terminal Tower building, Cleveland, reports that seven new members have joined the organization. They are as follows: The North Jersey Foundry Co., Grand and New streets, Paterson, N. J., J. T. Smith, vice president; the West Bergen Iron Foundry, 21 Pollock street, Jersey City, N. J., Fred R. Powell, proprietor; the Standard Foundry Co., Southgate and Armory streets, Worcester, Mass., Harrison B. Hoyle; the George H. Lincoln Co., 191 Old Colony avenue, South Boston Mass., H. V. Evans, general manager; the Waltham Foundry Co., 71 Felton street, Waltham, Mass., T. I. Curtin, president and treasurer; the Ridge Cast Products Co., Mineral Ridge, O., E. Ward; and the Allyne-Ryan Foundry Co., Aetna road and East Ninety-first street, Cleveland, D. J. Ryan, president and general manager.

Saw Is Direct Connected

Oliver Machinery Co., Grand Rapids, Mich., now has on the market a direct-connected, portable, lamp-socket, band saw with 18-inch wheels. The feature of the machine is the miter table with cross cut gage and parallel ripping fence. It has a large capacity, being able to handle 18 inches between saw and column, and is 8 inches high under the upper guide. It can use saws as large as ½-inch wide and by using gages will rip up to 11 inches and will cross cut and miter up to 8 inches. The wheels are made of cast iron and are 18 inches in diameter with a ½-inch, rubber covered face. They are guarded with steel doors, equipped with ball-bearings and at-



SAW WILL RIP UP TO 11 INCHES AND WILL CROSS CUT AND MITER UP TO 8 INCHES

tain a speed of 900 revolutions per minute. The upper wheel has a 4-inch vertical adjustment.

The table is of cast iron, ribbed and accurately machined. It is 20 x 24 inches, carries a ripping fence and cross cut gage, tilts 45 degrees to the right and is 20 inches up from the base. When supported on the base, it is 38 inches from the floor. The column of the machine is a one-piece, cored gray iron casting and is accurately machined. The floor base is a one-piece, cored, gray iron casting. It is accurately machined to fit the bottom of the column and usually is furnished but may be omitted if desired.

The machine is furnished with either belt or motor drive. The motor driven machine is of the built in on shaft type. The belt driven type has a yoke with ball-bearing, loose pulley and belt shifting mechanism. Ball bearings are used throughout the driving mechanism.

Core Machine Is Driven by Motor

Wadsworth Core Machine & Equipment Co., Akron, O., has introduced a portable motor-driven cutting off and coning machine with a capacity of ⅜ to 2¼ inches. It is powered with a ¼-horsepower, 110 volt, alternating current motor, controlled by a push button switch located at the operator's right. All working parts of the machine are guarded and it is lubricated from convenient points. The apparatus is equipped with guarded cutting off and coning wheels, a swinging rest for holding the core while it is being cut off, a graduated scale and a movable stop which may be adjusted to give any length of core desired. The coning wheel is equipped with an adjustable rest allowing the operator to make any desired taper or cone at the end of the core.

That company also has placed on the market a motor driven coremaking machine which corresponds to the No. 1 made by the firm and takes the same dies and accessories. Capacity is from ⅜" to 3 inches. It is direct connected to a 1/3-horsepower motor equipped for 110 to 220-volt alternating current. A safety clutch is incorporated in the drive, which prevents burning out of the motor, protects the gear teeth and takes care of any interruption that may occur by allowing a slippage. The machine is lubricated at four convenient points and is controlled by a push button switch located at the operator's right.

Bronze Companies Merge

Negotiations have been completed for the merger of the Wisconsin Ornamental Iron & Bronze Co., 1647 Booth street, Milwaukee, with the General Bronze Co., Long Island City, N. Y. The Milwaukee company was organized in 1894 by the late George H. Norris and has an annual sales volume of about $1,000,000 in ornamental bronze and iron work.

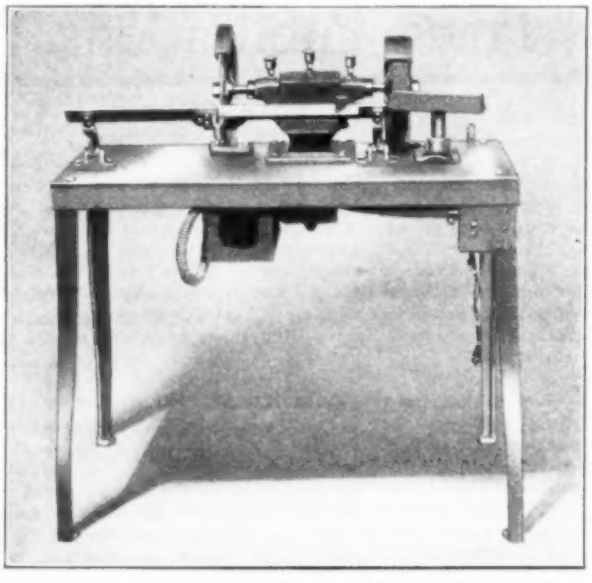
Builds New Plant

Ajax Metal Co., Frankford avenue and Richmond street, Philadelphia, recently has completed a new plant for the construction of electric melting furnaces. Facilities have been made for experimental work, storage space and handling facilities for service parts and lining materials. The new building is located on Frankford avenue below Girard avenue, Philadelphia.

Russia Awards Contract To the Austin Co.

Foundries for making gray iron, malleable and nonferrous castings are included in the general plans for an industrial town to be built in Soviet Russia by the Austin Co., Cleveland. Within the town will be factories to produce ultimately 100,000 automobiles annually, and homes for 25,000 workers. George A. Bryant Jr., vice president of the Austin Co., who has been in Russia for the past six weeks, has notified W. J. Austin, president of the company, that that organization was the successful competitor over a number of companies. The sum of $20,000,000 is involved in the project which the Austin Co. will carry through. The plant will be designed to produce 100,000 Ford cars annually and the Ford Motor Co., Detroit, will provide technical assistance in the equipment of the plant and assist in the manufacturing operations when the factory is completed. The engineering work will be handled in the main office of the Austin Co. in Cleveland starting Oct. 1st. The contract calls for a complete automobile plant to be erected on a site of 5000 acres.

The works will be erected by Soviet labor under the direction of the American construction engineers. In addition to quarters for 25,000 people, stores and other buildings will be built. Upon completion of the designing and engineering details of the project the Austin Co. will dispatch a large staff of experts to Russia to start the work of actual construction. The plant will be completed in about two years.



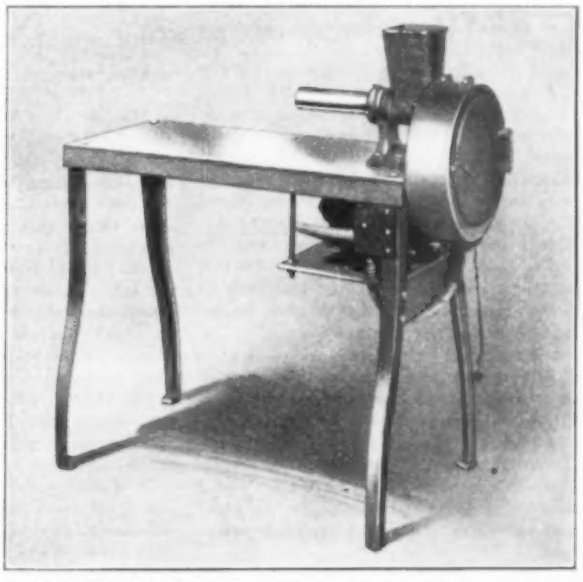


FIG. 1—CUTTING OFF AND CONING MACHINE IS DRIVEN BY A ¼-HORSEPOWER MOTOR. FIG. 2—CORE MAKING MACHINE INCREASES PRODUCTION OVER THE HAND OPERATED APPARATUS

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Iowa Malleable Iron Co., Ninth and Kirkwood streets, Fairfield, Iowa, is improving its plant.

Midway Foundry Co., St. Paul, will erect an addition to its foundry on Raymond avenue at a cost of $3300.

Fire recently damaged the plant of the Davis Foundry Co., Newcastle, Ind. Estimated loss is about $50,000.

Little Bros. Foundry Co., Port Huron, Mich., recently was damaged by fire. Estimated loss was about $2000.

American-La France & Foamite Corp., Elmira, N. Y., has closed its foundry at Utica, N. Y., and the equipment has been sold.

Traction Foundry & Machine Co., LaPorte, Ind., is equipping a building for general manufacturing purposes. (Noted Aug. 15.)

Wabash foundry Co., Wabash, Ind., is erecting a new addition that will increase its floor space by 7200 feet.

Texas Machine & Foundry Co., San Antonio, Tex., has been incorporated with $40,000 capital, by A. A. Jacobson, 1133 Essex street.

Gartland, Haswell & Rentchler Foundry Co., 1016 Herman avenue, Dayton, O., will build a cupola charging building estimated to cost about $20,000.

Williams Alloy Products Co., Elyria, O., manufacturer of bearing metals, is planning an expansion and improvement program including installation of additional equipment.

Los Angeles Steel Castings Co., Los Angeles, has been formed to take over the business of the Los Angeles Foundry Co., maker of steel castings.

Yale & Towne Mfg. Co., 200 Henry street, Stamford, Conn., is building a 1-story unit, 100 x 150 feet, and is making an addition to its foundry. (Noted Aug. 1.)

Saginaw Foundries Co., 930 Water street, Saginaw, Mich., has been incorporated with $200,000 capital by Fred W. Stork, to operate a foundry.

Bell Foundry & Casting Co., 1400 North Illinois street, Belleville, Ill., has been incorporated with $1000 capital by E. A. Schicktanz, to engage in a general foundry business.

Peoria Malleable Casting Co., Alexander street, Peoria, Ill., will build two 1-story plant additions as part of an expansion program totaling about $60,000.

American Foundry Co. Inc., Alameda, formerly the American Foundry Co. of Bay Point, Calif., has removed its plant and offices to Clement avenue and Oak street, Alameda, Calif.

Beaumont Iron Works, 1450 Crockett street, Beaumont, Tex., has plans for improvements and alterations to its plant estimated to cost about $50,000.

Western Foundries Ltd., Lethbridge, Alta., is planning to build a plant at a cost of $25,000. Two buildings are to be erected. One will be 48 x 80 feet, and the other 60 x 115 feet. Equipment and tools will be purchased.

Inland Mfg. Co., Dayton, O., subsidiary of General Motors Corp., Detroit, manufacturer of steering wheels and automobile parts, will build an addition which will double the present production capacity.

A. C. Williams & Co., Ravenna, O., advises that it has purchased the plant of the Universal Smokeless Boiler Co. and is equipping the plant with grinders, core ovens and cleaning equipment, etc.

Flint Foundry Co., 702 West Kearsley street, Flint, Mich., has plans for the construction of a 1-story foundry and office building. Wright & Nice, Dort building, are the architects. Estimated cost is about $100,000.

Central Brass & Aluminum Foundry Co., 503 South Twenty-first street, St. Louis, Mo., F. T. O'Hare, president, has completed an addition to its plant which will increase the production 50 per cent.

Phoenix Brass Foundry, 15 Newbury street, Danvers, Mass., was damaged by fire recently causing a loss estimated at $15,000. The plant was a two-story wooden frame building and was owned by James F. Alexander of Danvers.

Taylor & Fenn Co., 54 Arch street, Hartford, Conn., manufacturer of castings, etc., has awarded contract for a 1-story foundry addition, 54 x 180 feet, to the Allyn Wadhams Co., 15 Lewis street, Hartford. Estimated cost is about $50,000.

Master Electric Co., Linden avenue, Dayton, O., manufacturer of motors, awarded a contract to the Hofman Realty Co., for the construction of an office building and foundry addition. Estimated cost is $150,000.

Litchfield Mfg. Co., Waterloo, Ia., recently opened its foundry which has been closed since 1923. It contains 32,000 square feet of floor space. Two cupolas will be operated with a daily production of about 4 tons. Ten molders are employed at the present.

Ohio Pattern Works & Foundry Co., 2730 Spring Grove avenue, Cincinnati, has awarded a general contract to William Juergens & Sons, 4434 Glenway avenue, for a 1-story foundry addition. The addition and machinery to be installed will cost nearly $40,000.

Wisconsin Ornamental Iron & Bronze Co., 1665 Booth street, Milwaukee, recently merged with the General Bronze Co., Long Island City, N. Y., soon will start construction of plant additions which will practically double the present output.

The Semi-Steel Castings Co., St. Louis, H. P. Hubbell, president, has purchased a building adjoining its plant which will add 20,000 square feet to its present 60,000 feet. The company has bought additional equipment, including sand blast, tumbling and grinding mills and electric annealing furnaces, representing an investmet of $33,000.

Air Industries Foundry, recently organized at Wichita, Kans., has moved to a new building at 701 East Ninth street. Special castings for aircraft construction are featured. Lloyd Stearman is president and S. S Pierce, general manager.

Wilson & Nutwell, 140 Callish street, Fresno, Calif., manufacturers of ferrous and nonferrous castings, reports business good. That company took over the foundry of the Lisenby Mfg. Co., Fresno, Calif., about a year ago and since that time has added a pattern shop to the plant.

Lester A. Hicks has opened a brass foundry and builders hardware factory at 1736 Standard avenue, Glendale, Calif., under the name of L. A. Hicks Mfg. Co. Mr. Hicks formerly was president of the Pacific Hardware Mfg. Co., Los Angeles.

General Bronze Corp., Long Island City, N. Y., has purchased the business of the Guaranty Iron & Steel Co., 3847 West Lake street, Chicago, and acquired title to the one-story plant of the Guaranty company, which has a frontage of 240 feet.

Franklin Die Casting Corp., Syracuse, N. Y., L. J. Purdy, president, a subsidiary of the H. H. Franklin Mfg. Co., also of Syracuse, has bought the equipment and business of the General Die Casting Co., Reading, Pa. The latter company manufactures automobile body hardware. It is planned eventually to move the latter company's plant to Syracuse.

Rundle Mfg. Co., Cleveland street, Milwaukee, is completing a new eastern branch plant on the River road, Delair near Camden, N. J. The plant consists of a 1-story foundry, 150 x 325 feet; 3-story mill unit, 68 x 70 feet; 1-story enameling shop, 20 x 80 feet and other structures. The company plans to occupy the new plant in the near future. The entire project will represent an investment of about $1,000,000. R. A. Wickland & Co., 205 West Wacker drive, Chicago, are the engineers. (Noted May 1.)

New Trade Publications

ACCIDENTS—Metropolitan Life Insurance Co., New York, recently has issued a bulletin on the prevention of foundry accidents. The bulletin outlines the points that are necessary for the success of a foundry safety program and gives charts that may be used to determine the efficiency of the campaign. The second section of the bulletin is devoted to statements of foundry safety methods. It also contains a chart which analyzes the cause of foundry accidents as obtained from 208 foundries. At the conclusion of the bulletin is a list of the companies that co-operated in supplying information.

GRINDING MACHINES—Norton Co., Worcester, Mass., has published two folders on its swing-frame grinding machines. The first folder describes 16-inch and the second the 24-inch machine for high speed snagging. The bulletins are illustrated with assembled and disassembled views of the machines and contain a list of the features and specifications.

PYROMETERS—Maco Template & Engineering Co., 19 Cursitor street, London, describes its new type optical pyrometer for temperatures from 550 to 1200 degrees Cent. in a recent folder.

MOTORS—General Electric Co., Schenectady, N. Y., has issued a 32-page bulletin on its motors for driving metal-working machinery. It contains illustrations of the various types of motors and charts which aid in selection. Operating costs of different types are discussed as are installation costs, production, working conditions and control. The bulletin also contains many illustrations from photographs of motors mounted on various types of machines and several typical installations.

SAND HANDLING EQUIPMENT—Chain Belt Co., Milwaukee, recently has issued a bulletin describing and illustrating its sand handling and reconditioning equipment. It points out the advantages of the systems which it manufactures and shows reproductions from photographs of typical installations. The various parts of the systems are shown in detail and explained. Drawings of several of the installations are included. The bulletin also deals with the uses of mold conveyors.